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Regarded previously as a mystique, though served by vocational teaching of a number of particular but narrow techniques, management has appeared hitherto as a rather shapeless conglomeration of activities requiring much human understanding. It has certainly seemed more of an art than a science. Lately, however, quantitative aspects and theories have crept in, and though these may often be overvalued, they do hint at the existence of system and principle which are masked by the very complexity of the activity. Indeed, management today may be at the same stage of development at which technology, medicine and agriculture were two generations ago. And like them it may develop spectacularly within a generation or two.

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'Information' is to the communication specialist what 'energy' is to the power engineer. It has come to be recognized as one of the basic commodities of our civilization. Information theory gives us a new and powerful scientific tool for the study of all kinds of systems in which 'information' is a basic commodity. Communication systems (television, radio, telephone), automatic-control systems (in factories or aircraft, for example), human networks of social, economic or political relationships, the human body and the brain itself —all these and many others can be analysed in remarkably similar terms, and our understanding of them enriched by the recognition of the same fundamental principles in the most diverse cases.

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MANAGEMENT AS A TECHNOLOGY

by

ALEXANDER KING

Dr. King is a physical chemist whom the war drew from research into government service, first as Deputy Scientific Adviser to the Ministry of Production, them as Scientific Attaché and head of the U.K. Scientific Office in Washington. He next became the first head of the Scientific Secretariat of the Office of the Lord President of the Council, and later Chief Scientific Officer in charge of the Intelligence Division of the Department of Scientific and Industrial Research. He was Chairman of the Productivity and Applied Research Committee of the European Productivity Agency (OEEC) for several years, and is now Deputy Director of the European Productivity Agency.

In a previous study dealing with the changes brought about by science in the pattern of industry,[1] it was argued that the present spectacular changes in industry and, indeed, in the myriad features of everyday life, are the result of an evolving process which has been operating for at least 200 years. The growth of the natural sciences is contributing massively to this process, but the possibilities offered by science are becoming so bountiful that man's capacity to exploit them is limited mainly by economic and social factors. This is already so with the development of nuclear power and automation, which are not only producing social and political changes, but whose rate and ease of innovation are determined by social and economic conditions.

A dominant feature of this new technological world is its complexity, and there are many, especially amongst those educated in the humanities, who feel that it will soon be beyond man's power to control. Yet, from whatever background or nation we may come, it must be recognized that this is a major and irreversible world trend, resistance to which can only be futile. The alternative is to study problems of technical change, to regard the complexity as the great opportunity of our times, to attempt to master it, to modify its course and to use its momentum for the benefit of mankind.

The results of recent technical change already surround us; they are obvious in our work-places, whether in new industries or in the fields, in new materials and products, in our homes, in methods of transportation. A large proportion of the contents of our newspapers, whether concerned with political, economic or social questions, or with the functions of society, would

1. See, A. King, 'Science and the Changing Pattern of Industry', *Impact*, Vol. VII, No. 1, March 1956.

be meaningless to our fathers. As this is written, the British Prime Minister, introducing a foreign policy debate in the House of Commons, has been saying, 'Science, as usual, is ahead of us'—it has indeed abruptly altered foreign policies, revolutionized the problems of defence and is changing the education of our children. We are, in fact, almost without realizing it, witnessing the birth of a new civilization which differs from that in which most of us were brought up much more starkly than the Renaissance did from the Middle Ages. But this process is as yet at an early stage, and much adjustment has still to be made. This is one of the difficult and painful tasks of our particular generation in which old and new exist side by side. The contemporary applied scientist, for example, is preoccupied with a world completely unknown to most of his neighbours, and even if it were known it would be alien to them. To the scientist and engineer, conservation of matter and energy and concepts such as entropy are part of his intuitive thinking; he tends to look at phenomena quantitively, and while his personal life may be no better managed than the next man's, his statistical approach, and his feeling for the significant in a situation are quite different. All this is indeed utterly alien to the thinking of his neighbours and to those of his colleagues who have not had a scientific education and look at life in a classically derived, qualitative and unexperimental manner. If this is true in Europe and the U.S.A., the difference between old and new is still more striking in countries such as India with its rapid rate of development, or in Africa, where development is just beginning and where the completely primitive man exists side by side with the highly educated modern technologist.

We must strive to effect a reconciliation of the two cultures. It is unthinkable that a high proportion of the world's people, even of those who are literate and educated, should be out of touch with the dominant movements and thought of our times, enjoying the fruits of technology but ignorant of its basis in science, and thus becoming increasingly depressed and frustrated. Equally, we must ensure that our rich inheritance from the past is incorporated in the new culture, that scientists and engineers have a broad understanding of it; otherwise there is a danger that specialization and overspecialization will produce men blind to all but their own narrow image of the world. Such a state of affairs would favour the growth of a technocracy and end in a sterilization of the human spirit.

Present and impending change, therefore, will make demands on our educational systems. There is great need to foresee and to prepare for change and not merely to react belatedly to it. Basic rethinking is required if education is to be appropriate to both vocational and cultural needs. There are a number of separate, and at first sight contradictory, needs for modification of systems of education and training in most countries. These are as follows.
1. To provide a basic, true education of all citizens to equip them for life in

the new technological world, without loss of the cultural heritage of the race.

2. To provide a great increase in the number of scientists and engineers, many of them trained to a high degree of specialization.
3. To review methods and types of vocational training.
4. To develop an education especially intended for leaders of the new society, whether in industry, trade unions, politics or the public service.

The main purpose of this article is to discuss the last of these, namely, the education of the managers of the future. Nevertheless it should be realized that all four needs are intimately inter-related, and will consequently be discussed briefly.

GENERAL AND SCIENTIFIC EDUCATION

General school education will only be considered here as a preparation for the later training of scientists and potential managers. Some understanding of the achievements and methods of science should be impressed upon all children, and it is essential for those who will later become scientists and managers. Equally, basic teaching must not be such as to deaden receptivity to scientific concepts at a later stage. More potential recruits to science have been lost by dreary teaching of mathematics between the ages of 8-14 years than from any other cause.

In nearly all countries there is a considerable and growing shortage of scientists and engineers. This has all the usual features of scarcity, including rising costs and 'hoarding'. This shortage is all the more serious because demand is soaring, while supply remains static or is only slowly rising. In most countries the shortage is self-aggravating in that the salaries of science teachers fall further and further below those of scientists in industry or even in government service. Consequently not only is there an absolute shortage of younger science teachers but, apart from a few with a sense of vocation, scientists of enterprise or character are not attracted to the schools. This does not apply in the same degree to other subjects, and there is undoubtedly a more inspired teaching in history or languages, for instance, than in science.

The situation is apparently quite different in Russia, where scientists of quality are attracted to the teaching profession by good pay and a good status in the community. In other countries this problem calls for urgent and vigorous action if the situation is not to deteriorate still further.

At a recent conference on scientific manpower held in Vienna by OEEC, it was claimed that less rather than more science teaching was needed in the schools, but that a considerable effort should be made to stimulate interest in science at an early age and to develop it consistently until about the age of 15-16, when serious teaching of science can begin. More use could be

made towards this end of a whole series of new visual aids, including television, of science clubs, even of occasional visits of industrial scientists to the classrooms.

Intelligent teaching of mathematics, however, is an essential preparation for a later scientific or indeed for almost any career.

In many countries the system of general education is still too rigid to allow of such an approach, or indeed to permit a real cultivation of the experimental method. There is no doubt that the needs of our new scientific and technological society will require a serious modification of many national education systems as well as the status and pay of science teachers.

SKILL AND TRAINING

Before considering the question of preparation for management, something must be said of the effect which technical change, including automation, is having on the nature of industrial work in general and on preparatory training for it. One of the most striking tendencies throughout industry is that towards continuous rather than batch working. This trend is already highly developed, of course, in the chemical and process industries, where the materials involved are fluids which can be moved from one process position to another by gravity or pumping. In the assembly of automobiles or domestic equipment, continuous lines ensure something of the same effect—although, unlike in chemical manufacture, men and women attend the line and much of the assembly is done by hand, even though power tools of all kinds are available to reduce the physical effort. In advanced engineering production the use of complex transfer machinery provides a situation not unlike that in the chemical plant or oil refinery. Pieces of metal of complicated shape are moved from one precisely determined position to another, and operations are carried out automatically.

This tendency towards continuous production is associated with a complex technology and long runs of productions. It has great influence on the tasks of both management and labour. There will be a decrease of machine-paced work, i.e., work where there is a human link between powerful and complicated machines—a condition characteristic of semi-automatic production. In many instances, there is a reduction of individual craft work and a downgrading of skills. At the same time there is an increasing demand for men of high intelligence, not so much because of the readjustment of tasks within the single plant, but because of the ever more complicated design of plant and instrumentation, the construction of engineering prototypes and chemical pilot plant, and technical control and maintenance. These needs will provide greater opportunities for those with high abilities and initiative than even skilled work does today. Training facilities for these highly skilled people

will have to be provided in many specialized fields as well as by a sound basic technical education.

Apart from an increasing tendency to select an ever greater proportion of the population for higher technical training, a fundamental change in the nature of work on the plant is undoubtedly taking place—a change towards supervision rather than direct manual participation in the process. This requires a general understanding of plant and process as a whole, rather than dexterity and craft skill with regard to a single part of it. According to the degree of automatic functioning of a process, this supervision will involve greater or less judgement and action. For example, in a continuous process without full feed-back control, it will be necessary for the operative supervisor to read instruments, sometimes numerous and complex, at times to determine a trend of events by interpretation of the readings, and to take action to change this trend to one predetermined as desirable. In more fully automatic plants, much of this work may be done without intervention of either the mind or hand of the operative. But here his control function in the case of breakdown or emergency becomes more important. He has to react quickly to visible or audible signals and understand both machine and process in order to co-operate intelligently with the management and with the technical specialists to whom he is becoming more and more directly responsible. The increasing scale of production and the growing cost of complex plant makes the damage, waste of material and loss of production which may result from delay in recognizing or reporting a fault much greater than in the past. This does not necessarily imply that difficult decisions have to be taken or that a high degree of technical knowledge is required, but rather that there is need for intelligent co-operation, reliability and a sense of responsibility.

This change in the nature of industrial work already necessitates a new attitude to education and training. It may be that the introduction of new processes will be sufficiently gradual to allow present curriculae and methods to be modified as and when need arises: much of the re-training of operatives at a plant which is changing process can be done early and quickly, and it is normally accepted without difficulty by the operatives if sufficient consultation and information has preceded the change. It is true that there may be some hardship, particularly to older workers, as a result of the re-allocation of work which follows such a change.

What is certain is that we have insufficient knowledge of the nature of the physical and mental demands created by these new tasks on which to base appropriate training facilities. Much analysis of change and a wealth of case material are required.

CHANGES FOR MANAGEMENT

If all these changes in industry are bewildering for the operative, they throw even more problems of adjustment on to the shoulders of the manager. Indeed, one of the most pressing of contemporary needs is to produce a sufficient number of enterprising and competent leaders of industry and society, capable of facing up to the demands of the increasingly complex and science-based economy which we are now entering.

The decision to change, to introduce a new process or manufacture a new product, can scarcely be made by someone who is unaware of the nature of the processes and products with which he is dealing. It is for this reason that today a high proportion of the directors of the larger corporations in the U.S.A. and Europe are trained scientists and engineers. But in the smaller firms, especially in Europe, there is still a lack of technical knowledge in top management; there are still too many people in charge of firms who are frankly dismayed and perplexed by prospects which they do not understand. In the U.S.A. it is quite common for a university engineering education to be regarded as a suitable training for the young executive, even if his job does not necessitate actual engineering practice. It is realized that the capacity for orderly thinking given by such an education fits a man for the organization or operation of a transport system or a department store. In Europe, on the other hand, the 'loss' of an engineer to executive work is often regarded as a shocking waste of his training.

In the science-based industries, the main job of the manager often consists in reconciling various specializations, not only those relating to the many techniques and sciences which may be involved, but also those bearing on finance, market research, sales and personnel management. The introduction of an automatic process, for example, requires in the first place the taking of a difficult decision, usually in the absence of sufficient costing data or market assessment. This needs planning months and years ahead, and calls for a firm grasp of market possibilities, because of the heavy capital investment involved, and of the relative inflexibility of modern plants in terms of what can be produced. Furthermore, it is essential that the changes be accepted by the operatives and their trade unions. This in turn necessitates an honest and detailed consultation at an early stage, a wise employment policy, and probably the establishment of in-plant training schools. Often the manufacturers of the new equipment contribute to the setting up of such schools.

Once the plant is established, careful planning is again necessary if a high output is to be achieved. Suitable programmes of operation must be established to ensure that the equipment runs as continuously as possible, that it is maintained in optimum running order, and that it is flexible. In many industries the complexity of modern processes is necessitating a constant

increase in the number and variety of technical experts, and a consequent modification of the structure of line management.

All these matters call for very high personal qualities on the part of management, and especially of top management. Although competition for the services of men of ability in modern industry, whether private or national, favours the emergence of exceptional people, there is nevertheless a great need to provide the managers of the future with the kind of education and training which will help them to rise quickly within industry. Much attention is being given to this problem, and comprehensive systems of education already exist, especially in the U.S.A.; but there is as yet no general agreement on the best method of producing managers. It is not argued here that scientists and engineers make better managers than men trained in other disciplines, but rather that some science and engineering is a necessary ingredient in the training of most managers of the future.

But this by itself is not enough. Personal leadership qualities, sound judgement, skill in making decisions, a feeling for organization and for assessment of personal qualities, are only a few of the gifts required, in addition to technical understanding. Most of these are intangible and it is not immediately obvious how they can be nurtured. It is for this reason that there is still so much uncertainty about the best methods of educating and training for a management career. Moreover, a good manager's knowledge contains an element of instinct which grows through experience and cannot be directly imparted to raw youths who have not gone through the mills of failure and success. Management training has, therefore, tried either to concentrate on the teaching of a group of useful but largely unrelated techniques, particularly those of engineering production, or to use a clinical approach and teach on the basis of direct assimilation of the experience of others.

MYSTIQUE AND TECHNIQUE

There are many who still claim that managers are born and not made; that the successful business executive is a special type of individual, distinguished from his neighbours by indefinable qualities of authority and leadership which give him an inborn capacity to plan or organize the work of others. There is certainly much truth in this view, but it is an incomplete picture, and applies more to the past than to the future. The outstanding manager undoubtedly does possess specific qualities of intellect and personality which fit him for his job, in exactly the same way as does the doctor with his trained observation and his sense of vocation, or the research physicist with his scientific objectivity. Few, however, would maintain that the born physician or research man should be left alone to develop his God-given endowments without special training for his profession. The difference in the case

of the manager is that we are not yet quite sure what training he should be given to enable him to develop his natural gifts and to acquire the particular knowledge necessary for his future career.

The concept of management as a mystique naturally appeals to many of our most successful business men, especially since they have worked themselves into positions of authority through the hard school of experience and struggle, without the advantage of any special training in management. This could not be otherwise since there were no such training facilities when they entered industry, and in any case at that time there were few possibilities in most countries for those without private means to prolong their education. But today opportunities for further education are available in many countries to men of ability; more managers of the highest quality are required; and they have to attack problems much more complicated than those which faced their predecessors. Furthermore, with the advancement of the social sciences it should be possible to identify at an early stage and to analyse those qualities which distinguish a good manager, in order to develop them fully. Whatever improvements in selection and training may be introduced, personality and judgement will still remain qualities of primary importance in the manager; at least an element of mystique will remain.

It is frequently stated that the day of the entrepreneur is over, that the time is past when the outstanding man able to take a leap into the dark where others hesitated could open up and pioneer new territories. Nevertheless, in spite of the fact that nationalization, the growth of huge industrial corporations forced by modern technology, and high personal taxation make it more difficult, more risky and even irrational for the individual to start a major new enterprise, need for the function of the entrepreneur still remains. In the use of nuclear power, in the adoption of automation and of all kinds of new processes, it is often impossible, on the basis of available facts, to decide whether or not to innovate. Where many would hesitate, in the absence of proved markets or in the face of established fashion, to launch out with heavy capital investment, the exceptional man, who will see beyond the immediate facts and act with a conviction born only of intuition, is today needed more than ever. However, such a decision must to an increasing extent be a common decision of a well trained, imaginative band of directors —who today constitute the corporate entrepreneur.

The last few decades have seen a considerable growth of interest in individual techniques available to management. Of these, accountancy is the most general and the most precise. On the technical and production side, a whole series of quasi-scientific methods have been developed, such as work study and methods engineering; these aim not only at improving the nature of physical operations, but at providing a basis for payment of workers by establishing agreed work norms for the operation of systems of individual or group incentive. These techniques are of great value and serve to introduce

the feature of measurement and quantitative thinking into industry, though a substantial element of subjective judgement still remains at the basis of time study. Most of these techniques have been elaborated in the engineering and assembly industries, but their recent extension to manufacture as a whole, to agriculture, retail distribution, transportation and other activities, has given important results; these were particularly welcome in the period immediately after the last war, when the problem of productivity consisted mainly in making maximum use of static resources at a time when little investment capital was available for technical expansion. Similarly, there is a great increase of knowledge concerning plant layout, deployment of labour, statistical quality control, work simplification, and other techniques of immediate practical utility on the shop floor.

Another series of advances has been made through productivity measurement and the study of particular industrial operations. All these new techniques are of great assistance to management, but they are separate, and unrelated to any background body of principle; nor do they add much to the concept of management as such. The same is true of the corresponding growth of techniques on the social side, such as selection methods and job evaluation.

More recently, too, there has been a growing interest in the use of sophisticated mathematical approaches to industrial problems, mainly in the development of linear programming methods, the application of Neumann's theory of games, and the theory of queues. These are, of course, of significance in relation to future planning in large enterprises, but can scarcely be said as yet to contribute much to the thinking or equipment of the average manager.[1]

A further approach is by way of operational research, a group of techniques depending on the use of the scientific method in multivariant operational situations.[2] Operational research proved outstandingly successful during the war in securing optimum use of equipment and weapons. It seems to depend for its success on the establishment of a direct relationship of mutual confidence between the high commander (or manager) who must make decisions, and his operational research group. The operational research workers attempt a clear formulation of the problem, preferably in quantitative terms, and an analysis of the variables in order to assess the significance of each of them, and thus to present a rational basis for decision. The responsibility for the decision remains with the high commander, whose experience and intuition are thus brought together with the analysed data. The techniques themselves may be mainly statistical, but this is not always the case. Operational research, although it has been widely used, has not been

1. See, M. Verhulst, 'Mathematics for Managers', *Impact*, Vol. VIII, No. 1, March 1957.
2. See, R. T. Eddison, 'Social Applications of Operational Research', *Impact*, Vol. IV, No. 2, Summer 1953.

so successful in civil industry as in the military sphere. This may be due to two causes: firstly the difficulty of establishing an intimate working relationship between decision-making top management and the operational research group, and secondly the much more complex situation in which most industrial problems present themselves and in which intangible human qualities and motivations play so dominant a part. Physical scientists normally learn the scientific method in terms of the idealized models of thermodynamics or kinetic theory. They have shown that they can analyse real situations in war and peace, but are often somewhat naïve in hoping to solve by the scientific method the still more complex problems of human society. Nevertheless, some comprehension of scientific method is a useful attribute in any manager.

We need, therefore, both mystique and technique; yet it does not seem as if a pointer towards a rational education for management is to be found in either of these directions. It would be well, therefore, to look next at the approaches which have so far been made to the main problem.

THE SCHOOL OF BUSINESS

For a long time now it has been recognized that some vocational training is useful as a preparation for a commercial or industrial career. In special fields, such as that of accountancy, comprehensive and thorough professional training has long been available, while at lower levels vocational training has been provided through evening classes or at a great variety of commercial and technical colleges—mostly in the form of useful techniques rather than of theory and principles. For aspirants to top management, however, facilities have not been nearly so good. There are several reasons for this: first, there is disagreement as to what to teach, and then there is the even greater difficulty of knowing whom to teach. It is not easy to pick out potential managers at the age of 18. In Europe a large proportion of those who later rise to industrial positions of great responsibility leave school at an early age and enter industry without any definite idea of what type of career they aim at, although they have the ambition to get to the top. Others, with greater means or greater intellectual pretentions, enter industry only after a university education. But these have often read history or law, economics or the classics, mainly because commercial courses such as have existed in European universities have not had the intellectual appeal of the conventional disciplines.

Thus many of the highest type of candidates for management have entered industry and commerce with a more or less satisfactory general education, but with no professional knowledge. This has worked out well enough, but it is now becoming unsatisfactory as a preparation for the new world of

technology. This is now thoroughly recognized in Europe, and schools of business management are springing up in universities in all countries as a result of the productivity drive—and in spite of the lack of encouragement from the more traditional university departments.

Most of these experiments are based on the pattern of the American business school; for the United States were first to tackle this problem and to give comprehensive management teaching at undergraduate and post-graduate university level. The extent of the business school system in the United States is impressive, and the leading schools, such as Harvard, have undoubtedly been successful in producing so many of the most successful leaders of American business, and in keeping them abreast of new developments.

It is felt generally that research and discussion of the problems of business and industry in the leisured intellectual environment of the university has contributed much to familiarizing students with the nature of the problems of industry, to the fostering of the spirit of calculated enterprise, and to the maintenance of a progressive attitude in business. The outstanding success of American industry, with its genius for large-scale organization, its remarkably high levels of productivity, its rapidity of innovation and its open-mindedness, has naturally led many Europeans to wonder whether the methods adopted in the U.S.A. for the training of management do not provide at least one of the main solutions for substantial improvement elsewhere. This view is reinforced by the reports of productivity teams from different European countries and industries, who have come to the conclusion that the American worker does not work harder than his European counterpart, but that he works more effectively—because the management is superior.

It is important, therefore, to review briefly the American approach to business training. Though some of the methods of the business school have now become traditional, the system is in a dynamic state of development, and there is an energetic and wide-spread search for improvement.

Teaching of management and business administration is done at three different levels:

1. *Undergraduate schools of business,* which give instruction similar to that of British technical colleges and French commercial schools. Teaching is frequently given by means of special techniques as well as by formal lectures. At this level it aims at producing not leaders of industry or senior managers, but simply well-qualified employees, a proportion of whom will later rise towards the top of the hierarchy.
2. *Graduate schools of business,* many of which offer a two years' course leading to a master's degree for those who have graduated either in business or in other subjects ranging from history to engineering. The standard of teaching in these schools varies considerably, but it must be admitted

that only a small fraction provide instruction of a standard accepted in Europe as appropriate to a university.

3. *Centres of advanced management training,* mostly found attached to the graduate schools and seeking to give further training to men who already have experience in business. Here again, there is great variety of type and quality, but these centres are widely recognized as valuable in bringing together mature executives, freed from other duties and distractions for a few months, so that they can exchange views and experience in tackling together cases presented by the school.

It should be realized that these categories of teaching are frequently given within a single institution, although many of the better schools provide only graduate and advanced management instruction. The system is extensive, there being some 500 American colleges with schools of business, of which about 80 are of a standard recognized by the American Association of Collegiate Schools of Business. More than 300,000 students now graduate from these schools every year, representing some 17 per cent of the total university output. It is stated moreover that supply is still far below demand, and there are plans to turn out some 600,000 students per year by 1970.

Undergraduate courses are generally of four years' duration, the first two of which can be regarded as a continuation of general education; the last two years are devoted to management studies. At the better business schools, the average age of students in the graduate school is 25. Frequently two types of advanced management courses are given, one lasting 8 months for middle managers aged about 35, and another one lasting 13 weeks for men of achievement of about 45.

Methods of instruction in the United States are undoubtedly less formal and more practical than in Europe. The primary objective is not to teach a number of individual techniques, but to train individuals capable of analysing situations and of taking the right decisions. Of these methods the best known is that of the case study developed by Harvard, and frequently assumed in Europe to be the generally accepted method of teaching management in American universities. It is strictly limited in use, even in some of the best schools, and its basic validity is hotly contested in some quarters.

The Harvard 'case' is an account of a past 'situation', which serves as a basis for discussion by the students, guided more or less firmly by the professor who avoids, as far as possible, giving any sort of value judgement or indication of the solution. The essential aim is to give an opportunity to the students to analyse all the complex elements of a practical situation and to express an opinion as to what action should be taken.

Case material is generally collected from industrial business concerns by the younger faculty members, who may be assisted by a few student 'apprentices'. Normally the name of the firm is suppressed and its location disguised, and figures may be multiplied by some fixed factor to prevent the

source being traced. Harvard uses some 20,000 'cases', but great care is exercised not to use obsolescent material. Six or more textbooks of cases have been published, but it is felt that the use of this published material by other schools may discourage them from gathering their own case material.

While the importance of the case method may have been somewhat exaggerated, it is clear that a large part of the teaching of management in American schools of business is done by the transmission of real situation experience, together with practice in decision-making on the basis of this experience. It is, in fact, the clinical method of teaching used in medicine and the law, which is undoubtedly effective in subjects of great complexity. As a method of teaching men to think in terms of practical situations, and to take decisions of a type which they are likely to have to make in the future, it has great value and is obviously superior to the teaching of isolated techniques. It is not however a complete answer to the problem.

A number of criticisms of the case method have been put forward:

1. When conducted brilliantly as at Harvard and other centres where there are first-class professors who have been personally involved in gathering case material, the method provides lively and realistic discussion. But when taught from books and by lesser schools, case teaching can degenerate into mere dreary demonstration of dusty museum pieces.
2. It furnishes pupils with examples of successful practice, but does not help them to acquire principles.
3. It tends to suppress rather than to encourage the critical faculties of the more mediocre students, and forms in them the habit of thinking by analogies, the cases becoming permanent precedents in their minds for later, indiscriminate use.

In order to improve methods of teaching, a number of interesting experiments are in progress. One of these is the 'incident' method introduced by Professor Pigors of the Massachusetts Institute of Technology, formerly a professor at Harvard. Instead of being presented with the full 'case' in all its details, the students may be presented with just the outline of a situation, possibly by the expression of a complaint. It remains for the group of students to dig out the facts, which at first often appear contradictory, from the professor, or perhaps—as in a play by Pirandello—from the live participants of the real case, in order to get the full picture of the situation. Professor Pigors attempts to make the pupils search out all the elements as well as to analyse the situation. He does not hesitate to guide them towards a solution when necessary. The resolution may be arrived at through the technique of 'role playing'.

The case method, or modifications of it, is taught in more than 100 American business schools, although in many of them it is regarded as just one of a number of useful teaching methods. In one prominent centre, for instance, the following are used: the formal lecture, particularly for subjects such as

economics and for the exposition of principles; the freely interrupted lecture; the seminar; the case method; writing of reports; the occasional visit by a business man or production manager who expounds the details of a situation he is facing. The students cross-question him, and, after he retires, discuss the problem in detail and suggest solutions. Later the visitor may return and describe the solution he has, in fact, adopted.

It would be wrong to assume that only the schools of business in American universities are concerned with management problems. Almost since the beginning of the century, certain engineering schools have interested themselves in teaching and research on 'production engineering' with the object of training men to become production managers. This was at first often only a modification of mechanical engineering curriculae and the cultivation of engineering management methods, but there has been a strong trend towards the teaching of a broader field of management in directions different from that of the business schools, taking into account the complex technical environment in which the manager of today must make his way. The Sloane School of Industrial Management of the Massachusetts Institute of Technology and the Carnegie Institute of Technology at Pittsburgh are pioneers in this direction. At the Massachusetts Institute of Technology, for example, there are interesting undergraduate courses for management education based on chemistry or physics, which aim to produce men intending to find a career in management, but wishing to acquire also a basic scientific background. For the first two years the pupil reads mainly the basic sciences, but later a larger proportion of social, economic and management subjects is taken.

Both these institutions still have an open mind as to which is the best approach to education for management, and many experiments are being tried. On the whole the tendency is to base teaching on the analytic scientific approach rather than on case analogy borrowed from the law. In both instances there is a strong content of social science in the curriculae. At Carnegie great attention is paid to the subjects, both in natural and in social sciences, on which management is based. This school, which is still very new and considered by some as excessively sophisticated, rejects the normal approach of the business school. The entrants to its master's course have mostly graduated in engineering or science, although they may come from other disciplines if they have reached a reasonably high standard in mathematics. Many already possess some experience of industry. It is considered unwise to attempt to produce ready-made managers able to apply a few of the current rule-of-thumb techniques; instead, stress is laid upon the acquisition of basic knowledge, cultivation of the analytical approach, clear thinking and a quantitative sense. This is in fact education as distinct from training, and it aims at equipping men who, on entering industry, will not expect to know the answer to every problem, but who will develop quickly and have sound judgement.

It is interesting to consider the stated objectives of this school: (a) a thorough and integrated understanding of the content of fundamental knowledge of industrial administration and engineering science; (b) competence in the orderly, analytical explanation and handling of problems; (c) a basis for communication and dealing effectively with people; (d) receptiveness to new ideas and learning from experience; (e) thorough understanding of the economic and social system; (f) independence of thought and maturity of character.

These, if they could all really be achieved, would be the answer to the complex needs described earlier. However, such teaching is still in an experimental stage and must evolve further. It is freely admitted that there is not yet a sufficient body of systematic material for teaching with sufficient breadth and depth. The concept seems to be to educate an elite which can think quantitatively and be predisposed to innovation. Much more will be heard of this experiment. It is perhaps significant that out of the Carnegie faculty of 30, only four members are from the traditional business schools.

Apart from business and engineering schools, important work on management methods is being developed in a number of American centres for industrial and human relations, of which there are some 40 in the major universities. Again, many of these organizations are frankly experimental in their approach, but in general their development is linked to social research, and they frequently work in close relationship with individual industrial firms. Much stress is put on the unfathomable subject of human motivation and on decision making, and some of the centres concentrate on the newer concepts of group behaviour and decision.

MANAGEMENT AS A TECHNOLOGY

In spite of this wealth of experiment, continued uncertainty on the teaching of management as a subject leads one to question the nature of the management activity itself. Regarded previously as a mystique, though served by vocational teaching of a number of particular but narrow techniques, it has appeared hitherto as a rather shapeless conglomeration of activities requiring much human understanding. It has certainly seemed more of an art than a science. Of late, however, quantitative aspects and theories have crept in, and although these have often been overvalued by their proponents, they do hint at the existence of system and principle which are masked by the very complexity of the activity. Perhaps it is merely the primitive state of development of the subject that obscures its real nature.

That was true in the early stages of the growth of the physical sciences, and even more so of engineering, agriculture and medicine. Indeed management at present appears to have many of the characteristics possessed by

those three applied sciences when they were at the stage at which the fundamental sciences, on which they are now seen to be based, had not evolved sufficiently to allow of application, or even of the interpretation of phenomena. For many years, for example, until thermo-dynamics had been developed and chemistry and physics had grown to be relatively mature, engineering was mainly a matter of invention.

Medicine likewise still remains a descriptive subject, taught by clinical methods for the acquisition of experience. But as physiology, biochemistry, cytology and other of its basic sciences develop, medicine will become increasingly a technology based on the application of a wide group of fundamental sciences; though in its practice—and especially in diagnosis—intuition may still be as necessary as knowledge. Teaching of medicine will continue to consist partly of providing a knowledge of the underlying sciences, and partly—through clinical methods (case-study)—of communicating experience.

Management appears to be developing in the same direction. Its systematic pursuit must in the future depend more and more on the subjects which fundamentally underly it and which are themselves still far too rudimentary to allow of much practical application or of precise interpretation of phenomena. These subjects include economics, psychology and sociology, statistics, probably mathematics, communication theory, systems of organization and certainly the scientific method. As each of these enriches itself in those features which are of concern to the technology of management, the latter will become more systematic and will acquire precision. This stage is as yet a long way off; meanwhile much of the teaching of management must remain on a clinical 'case' basis, though research will continue to strengthen the foundations.

It must not be concluded, however, that management, in becoming a science, will cease on that account to be an art. Like all creative activities, including medicine and scientific research itself for that matter, management, if it is to be inspired, will have to be a mixture of intuitive and rational activities.

EDUCATION OR VOCATIONAL TRAINING

If there is any value in this method of approach, the American experiments become very significant in relation to the training of our leaders for the new world that science is building. It would seem that the 'case' approach has an enduring validity, but that it is in itself insufficient; it appears also that research is necessary and urgent, and that particularly old traditional Europe should, in creating schools of management, consider how to fit the new ideas into the existing pattern of things.

It is mainly to the United States that other parts of the world must look

for precedents, since it is the only country where there has been as yet much accomplishment and experiment. But we have to discriminate. The undergraduate teaching of business in America is in the main remarkable for its extent rather than for its quality. Undoubtedly it has its value in producing large numbers of qualified people who are given the opportunity of improving their background education and of gaining some familiarity with management concepts and techniques. In view of the differences in the education systems, however, it is doubtful if the undergraduate business schools of American type could have a place in the European university; teaching at this level is probably best left to other institutions. The European concept of the university as a centre of learning where young men and women are equipped to think rather than to receive a detailed vocational training is nowhere completely adhered to. In medicine, the law and engineering, the two approaches—to learn to think and to get a vocational training—are inseparable, and it must be so with management. The frankly vocational without the fundamental is abhorrent to most European universities.

The needs of our new world are very varied, and certainly no one way of providing its leaders will suffice. Some men, without any initial intention of becoming managers, will come directly from science and engineering, which provide a good training for the later development in management of men possessing a certain cast of temperament.

Others will no doubt be educated through technical and commercial colleges and rise late in their career. This, however, is likely to be less common than in the past. In Britain, for example, many industrial leaders have, until recently, risen without the benefit of a university education, and those who have graduated come from all the various disciplines. One of the most important points of intake into industry has been from the grammar school at the age of 16-18. Many boys of the highest intelligence entered industry at this stage, when they were sufficiently flexible to learn the numerous tasks within the firm and to profit quickly from experience. But this is no longer adequate for the much more exacting needs of the future. Fortunately, greatly increased financial opportunities are now available for university education. Accordingly, most of the more intelligent boys will now stay for about three to four years at university before entering industry at about 22. At this age they are much less flexible than at 18, with less time to work up from the shop floor, and less willing to do so. It is therefore particularly important that the university give a suitable preparation for a business or industrial career, without ceasing to give a true university education. It is questionable whether many of the degree courses, such as those in history, literature or the classics, which at present attract a large proportion of students who later enter business, do in fact provide the best foundation. It will probably be necessary to introduce university courses of a new type to fill this need. What then should these courses be?

Again no single answer can be given, except the negative one that these years should not be devoted to narrow vocational pursuits—at least in the case of the most intelligent students. In any case, it is difficult, if not impossible, to impart a sense of industrial life and of practical business experience to those who have never worked in industry. Moreover, training to this end could only be given at the expense of character development and general understanding, and would be strongly opposed to the ultimate objective.

It is to be hoped that all young men entering university in the future will have acquired some knowledge of the methods of science from school. A proportion of them, even if they have already decided to take up an executive career, should have a university education in science and engineering, although this should certainly also include some courses in production methods, economics and management. Experiments in mixed courses, similar to those of the Massachusetts Institute of Technology, should be worth undertaking elsewhere. In Europe, one or two years training in management, following graduation in science or engineering, will probably prove more successful.

A much larger number will no doubt wish to concentrate less on the sciences, and it is for these that a new type of instruction is desirable. The most promising line seems to be to adapt the methods at present being developed at Carnegie, but at a less sophisticated level. This would consist in teaching in the European universities, at undergraduate level, the basic disciplines on which the new technology of management must grow. These disciplines would include economics, sociology, psychology, statistics, institutional history, and at least one of the natural sciences from which to develop the concepts of the scientific method. A biological science would be particularly relevant if taught with the correct emphasis, since it demonstrates complexity of structure and organization, and many of its problems are multivariant, requiring statistical attack.

In the later stages of such a course, some approach to the problems of decision-making could be introduced, and also some teaching of the theory of organization. The aim, however, would remain the development of clear methods of thinking and communication and judgement, and an understanding of the social structure, of human motivation and group behaviour. Such a grouping of subjects would be more relevant to the future managerial order than conventional education in the arts or law. Its concentration on basic principles and underlying disciplines approaches very closely the classical ideas of the university function and would not offend academic susceptibilities. After four years of such preparation, men would be ready to enter industry with open minds; they would be capable of developing quickly, without having the naïve attitude that they already know all about it, derived from a more directly vocational approach. At the postgraduate stage, too, it would be possible to spare some time on more vocational aspects, such as finance, marketing or production methods.

While there is much to be said for a new approach at undergraduate level based on true education, there is an equal need in most countries for exchange of experience and advanced vocational training to be given to those who have acquired at least four years experience in business. The success of Harvard and other schools in providing longer separate courses for middle management, and shorter for those who have already reached the higher ranks, can be emulated. But advantage should be taken of such opportunities to introduce into these courses new ideas and approaches to this quickly growing subject, and to impart some sense of the significance of new scientific discoveries and technical developments.

RESEARCH

In all subjects where development is rapid, teaching only remains alive when it is closely associated with research. This is certainly true of management studies and, indeed, one weakness even of some of the best American schools of business has been their preoccupation with the collection of case material to the exclusion of deeper investigation and research. It should be noted, however, that it is in the least traditional of the American schools that research is particularly vigorously cultivated.

Furthermore, if we regard management as evolving towards becoming a technology, it is clear that research on this subject can only be superficial, as was the case with engineering or medicine a century ago. This does not mean that investigations of contemporary management are worthless; on the contrary, much useful descriptive study remains to be done. But the primary need is to probe deeper, and our present thesis would lead to the conclusion that research is mainly required on the fundamental subjects upon which the technology of management must grow—especially on psychological, social and economic aspects.

In economics, academic interest has been mainly focused on broad national and international aspects, such as national income statistics, balance of payments questions and allied problems. It is still difficult to secure the interest of economists for micro-economic problems. Yet in relation to management and to industry in general, there is a whole complex of problems arising out of modern technology which require to be studied: the economics of innovation and decision-making, the provision of capital for re-equipment, the problem of mechanization of particular equipment in terms of one-, two- or three-shift working, the economics of inspection and instrumentation, the significance of component standardization in relation to run of product and to design practice, optimum size of particular plants, the economics of research, etc. These are the types of subject which have to be tackled and which at present tend to be dismissed by the engineer as

being the province of the economist, and by the economist as being the province of the technologist. It is only by the extension of such studies that management will be in possession of all the data on which to plan; consequently it is to the new schools of management that we must look for activity in this direction.

The same is true for the social sciences. Here the problems are even greater and, owing to the still rudimentary nature of social research tools, more difficult to tackle. We know too little concerning the nature of the management hierarchy, for example, in relation to different types of manufacture. Yet in the absence of facts, there is much over-generalized statement of pseudo-principles on this topic. We need to know much more about vertical and horizontal two-way communication in industry, about social determinants of change, about the impact of the ever-increasing number of functional specialists made necessary by complex methods, on the normal line-management structure, on the nature of skills, on the delicate subject of industrial relations.

Even the anthropologist has much to contribute to an understanding of accepted production norms. There is no end to our ignorance of the real nature of industrial situations, while at the same time we are uncertain if the social sciences are yet in a position to give any answers. One thing is clear: unless research is extended and intensified, management will remain partly a rule-of-thumb and partly an intuitive business. Research on such problems, if well prepared and supported by both management and trade unions, can at least help to formulate problems clearly, and, as in all science, that is the first step towards their solution. It is true also that by involving managers and union representatives in discussion on such topics, there is a fruitful gain in experience and understanding.

If management schools are set up in various countries, therefore, they should quickly establish live schools of research, working by means of social and economic investigation on practical problems. Only then will the foundations of the new technology of management be firmly built. Rapid results should not be expected: decades of work will be necessary before firm principles are established and results can be applied with some measure of precision; but in the meantime, the by-products of such work, in the form of clearer understanding, will amply justify the effort.

CONCLUSION

Change is inevitable, and there is always resistance to altering ways and ideas. The rapid development of modern industries and communication systems in countries which until recently have been considered backward indicates that quite radical changes in thought and way of life can take place

rapidly, instead of being spread over centuries, as was the case in Europe. It becomes more and more obvious that it is not much more difficult for men to make a big change than a minor one. To a manager or an operative in an industrial society, the effort required in transferring from a traditional industry to one which is science-based may appear formidable. But it is just this need to face up to change that is the basic problem in all types of community, and it is common to both managers and operatives, to civil servants, to politicians, to agricultural labourers and to housewives. Leadership or good management, always scarce, will thus be more highly prized than ever. It is the key to the smooth and rapid exploitation of technical progress. It is therefore necessary to study and develop this complex and difficult technology of management, which still rests on many incomplete fields of learning. All men must change, but to change intelligently they must know more.

INFORMATION THEORY AND HUMAN INFORMATION SYSTEMS

by

D. M. MacKay

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INTRODUCTION

The organization of human society depends on the flow and exchange of information. In the era of radio, television, the press, the telephone, such a statement is trite enough. It is all the more remarkable that until recently no science of 'information systems' was in existence. Fifty years ago anyone who thought of information as something scientifically measurable would have been greeted with a smile. Yet today, largely through the work of communication engineers and physicists, a whole subject of 'information theory' has come into being, giving us a new and powerful scientific tool for the study of all kinds of systems in which 'information' is a basic commodity. Communication systems (television, radio, telephone), automatic-control systems (in factories or aircraft, for example), economic systems, the human body and the brain itself—all these and many others can be analysed in remarkably similar terms, and our understanding of them enriched by a recognition of the same fundamental principles in the most diverse cases.

This is not to say that the methods appropriate to one such system should, or can, be transferred wholesale to another. A certain amount of harm has been done to the good name of Information System Theory by hasty general application of its simpler principles to economic or political situations without regard to their greater complexity. The insights this theory offers into a variety of human problems are fundamental; it therefore seems important that some of its basic principles should be more generally known and their implications worked out by those competent to do so in the fields of human affairs.

MEASURING AND MAP-MAKING

The new theory has two main branches, or, we might say, two levels. One is concerned with the structure and measurable properties of information itself. The other might be called the study of systems organized by information-flow.

The first deals mainly with questions of *amount* of information: How much information have I gained from this experiment? How much information can be sent through this radio channel in one minute? What is the most economical way of representing a given item of information? How can I best safeguard a message against loss of information through disturbances? How can a filing system be designed to yield the maximum of information in a given searching-time?

The second is concerned chiefly with analysis of the paths along which information flows in an organized system—with information-map making, so to say—and with questions of the stability and efficiency of such systems. How can an unstable system be made stable, and at what cost? What are the effects of delay in an information channel? What happens if an active member of a system (e.g., an economic system) tries to predict what the system will do?

It is the second of these branches which has the greater relevance to human affairs, but a brief look at the first may serve to show how essentially simple and down-to-earth the basic notions really are.

BASIC IDEAS OF INFORMATION MEASUREMENT

Suppose that we are standing at a road-fork, and are equally uncertain whether to go to left or right. The amount of information we need, in order to identify one out of two equally likely possibilities of this kind, is defined to be *one unit*. The unit of information is that which enables one simple choice to be determined, between two equally likely alternatives: Left or right? Yes or no? In other words, information is measured by the narrowing down of the range of possibilities which it brings about. If the range is reduced by half, we say we have gained one unit. If it is reduced to one quarter (half $\times$ half), we say we have gained two units; if to one eighth (half $\times$ half $\times$ half), three units; if to one sixteenth (half $\times$ half $\times$ half $\times$ half), four units; and so on.

This is just the same arithmetic as in calculating the number of rounds required in a knock-out tennis tournament, in which half the competitors are eliminated at each round. The total number of rounds measures, roughly, the number of units of information gained when the winner is identified (assuming that we had no prior knowledge of the competitors' chances).

To put it in another way, the amount of information gained from an item (a message, an experiment, the result of a competition) is measured here by asking 'Out of how many equally likely competitors has this item been selected? How many equally likely alternatives were there? How unlikely was it?' In other words, for the purposes of this particular measure we are interested not in the nature of the item, but essentially in its unexpectedness. The greater the unexpectedness of an item, the greater the gain of information when it is received. As we have seen, the number of units of information is not proportional to the reduction in the number of competitive possibilities. It increases by one unit for every halving of that number—increasing as the logarithm of that number.[1]

Clearly this definition enables us to measure the amount of information gained even when that information is incomplete. If we were faced, for example, with four equally likely roads, and were told only that the road we wanted was one of two left hand roads, this would narrow the range from 4 to 2, and so give us one unit of information, just as would the identification of one road out of two.

But what, one may ask, is the point of measuring information in this way? The answer is severely practical. This is the measure which tells a communication engineer how much a message should cost him to transmit. The amount of information of a message determines the minimum number of code-signals it will require to represent it in an ideally efficient system. So by comparing this theoretical cost with the actual cost of a particular method, we have a solid mathematical measure of informational efficiency, which is as vital in the design of competitive communication systems as power efficiency is in the design of electrical supplies.

'Information' in fact is to the communication engineer what 'energy' is to the power engineer. It has come to be recognized as one of the basic commodities of our civilization.

SOME USES OF INFORMATION-MEASUREMENT

Human Language

One of our commonest instruments of communication is the alphabet. From the standpoint of information theory, a word or a sentence is a sequence of selections from the repertoire of possible letters, punctuation marks, etc.

Now there is a basic theorem which states that the informational efficiency of a given repertoire is a maximum only when all its symbols are used equally

1. This is strictly true only when the possibilities are all equally likely to be selected, but the details need not concern us. It is always true that the number of units increases as the logarithm of the mathematical improbability of the item.

often (assuming that all are equally costly). Since this is obviously not the case with the English alphabet, in which E and T are many times more common than for example X and Z, it follows that the English language does not use the alphabet with maximum efficiency. In the jargon of the theory, English shows a certain *redundancy* in its use of the alphabet. Because some letters and sequences of letters are so much commoner than others, it should often be possible in principle to guess them even if they were not transmitted. Indeed experiments have shown that sometimes as many as 50 per cent of the letters in a typical English text can be deleted at random without destroying intelligibility. English, the theorists say, has a redundancy of about 50 per cent. All other languages show a similar redundancy, though—is this significant?—none quite so high as English.

Now at first sight this discovery by the theorists might seem to indicate a serious defect of our language. The theory shows undeniably that if English were redesigned or re-coded to use the alphabet more efficiently, our books could be half their present length, our telegrams could be transmitted at half the cost, and so forth. But the pejorative flavour of the term 'redundancy' is misleading. For the very tests by which it is measured indicate that it is very far from being undesirable in practice. It is only the redundancy of English which enables us to spot misprints and to restore texts mutilated by disturbances in transmission or printing. A similar redundancy in spoken English enables us to listen to one conversation against a background of a dozen others, and to understand a telephone message half drowned by extraneous crackles and buzzes. An ideally non-redundant language would be one in which every single symbol was of equal importance and entirely independent of its context. It would be satisfactory enough for communication between perfect machines—many telegraphic codes indeed are of this kind. But in a world of imperfections and disturbances in both the transmitting channel and the receiver, redundancy is something for which to give thanks. Indeed, as every schoolteacher knows, it may often pay us to increase redundancy artificially by repeating the same information in as many different ways as possible. Any reduction of redundancy brings a corresponding risk of failure to communicate.

Information theory thus offers some much-needed criteria by which to evaluate proposals for linguistic reforms. Some changes might, for example, make words easier to spell, but at the cost of their informational efficiency.

Mechanical Translation

The theory has light to throw also on problems of translation from one language to another. The object here is to preserve the *information content* of the original, and the big question is whether, or to what extent, this could be done by a completely mechanical translator. To mechanize a dictionary

is not too difficult, given the necessary storage capacity in an electronic computor. The difficulty is to resolve the kinds of ambiguity which a human translator settles by an intuitive assessment of the context. For this we need a much deeper understanding of the structure of verbal information, and in several countries linguists have linked forces with information theorists and are actively engaged on this problem. It is too early to assess their progress, but it seems likely that with the help of two editors, each familiar with only one of the languages, a machine could be made to produce satisfactory translations of technical documents.

Filing Systems and Information Retrieval

The problem of translation is closely related to that of information retrieval —the design of filing systems for libraries and business firms. The flood of scientific papers published every year, to take only one example, makes the labour of identifying documents, and the risk of missing important information, ever greater. Information theory has suggested a fresh approach to this problem by showing its kinship with others facing the communication engineer and the linguist, and there are signs that the whole basis of information retrieval may be revised in consequence, so as to make selection of wanted material speedier and more secure.

INFORMATION-FLOW MAPS

What do we mean by saying that information flows or is carried from point A to point B? When the front-door button (A) is pressed and the bell (B) rings in the kitchen, it makes sense in terms of information theory to say that information flows from door to kitchen, even though the energy to ring the bell comes from a transformer which is in the kitchen. We can draw a simple map showing a line from A to B, and say that information flows from A to B, no matter what may be the flow of energy involved—where it comes from, or how much is required.

In the same way we can draw a map showing the lines of information-flow (or communication) between the units of an army and headquarters, regardless of whether the messages are conveyed by radio or telephone or signal lamp. The lines of our map are not meant to show what happens to the energy transmitted, but to depict the flow of information, in the sense in which information theory uses the term.

So, by saying that information flows from A to B, we mean that an action at A selects or determines the form of some action at B. Whether A also supplies the energy for B's action is another question. In general it does not, but merely specifies it in the sense in which the pushing of a button specifies

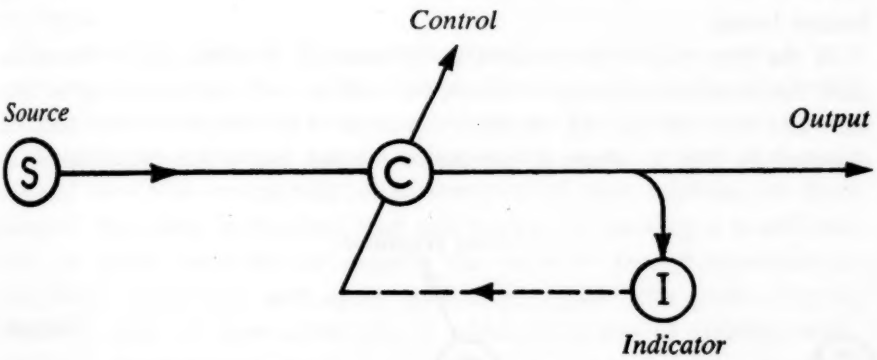
the instant at which the bell rings, or the turning of a tap specifies the force with which the water comes out.

Drawing an information-flow map, then, amounts to singling out one particular aspect of a situation for attention, concentrating on what specifies the form of activity, rather than its material embodiment.

Now the power of this method of studying situations lies in its great generality. Simplified though a flow-map undoubtedly is as a model of what goes on, it allows us to ask questions and apply principles which are far from trivial, and which cover an enormous number of particular cases that have hitherto been studied as separate problems.

A TYPICAL INFORMATION-FLOW SYSTEM

An example of an information-flow map which is familiar in many forms is shown in Fig. 1. It represents the informational 'skeleton' of automatic regulators such as the thermostat, the ball-cock and the steam governor. In each of these there are two essential parts: there is a control (C), by which the output drawn from a source (S) can be adjusted; and there is an indicator (I), which shows the difference between the actual output and some standard output.



In a domestic oven, for example, C may be a gas valve, and I a thermometer. In the water cistern, C is a water cock and I a ball floating on the water. In the steam governor, C is a throttle and I is a speed-indicator.

In every case, the system is made self-regulating by making the indicator work the control in such a way that any deviation from the standard output is self-correcting. Information from I is 'fed back', as we say, to C, in such a way that it selects automatically the required form of output from C.

Thus in the domestic oven the thermometer is mechanically linked to the internal gas valve so as to turn up the gas when the temperature is below standard, and vice versa. In the water cistern the ball is linked by a metal

arm to the water cock, so that the cock opens when the water level is below standard. In the steam governor the speed indicator is linked to the throttle so that the flow of steam is increased when the speed is below standard.

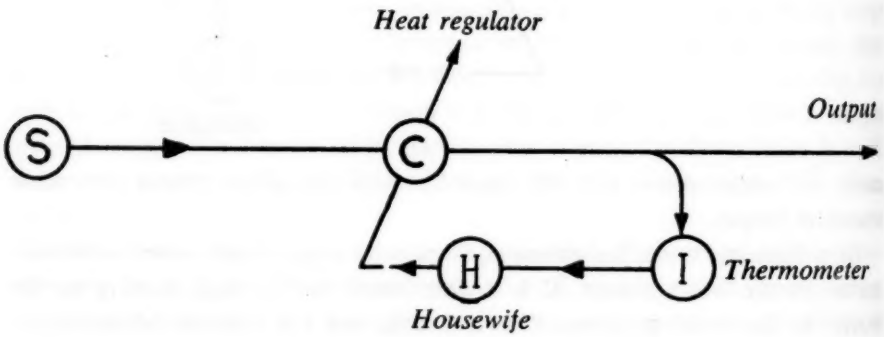
In every case the information fed back specifies action to *oppose* the change which has given rise to it. In technical jargon this is known as 'negative feedback'.

Suppose, however, that the thermometer in the oven were connected to the gas valve in such a way as to turn up the gas when the temperature rose above standard, and vice versa. This would be called 'positive feedback', and it would obviously cause the system to become unstable. Any slight rise in output would cause the control to open further and so accelerate the rise indefinitely. Conversely a slight fall would shut down the control and so initiate a cumulative drop in output.

HUMAN INFORMATION SYSTEMS

We shall have more to say later about the conditions under which systems of the type of Fig. 1 are stable and properly behaved. But first let us see how the same information map may be used to depict situations involving human beings.

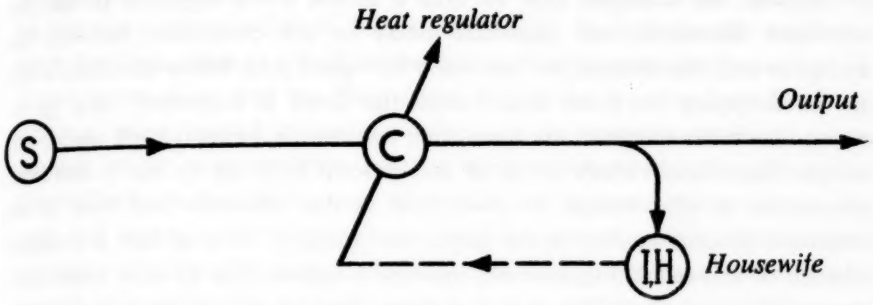
In the days before thermostats were invented, if a housewife wanted to hold her oven temperature constant, she had to read the thermometer herself, and turn the gas up or down by hand. The situation could then be depicted by Fig. 2, where C represents the tap and I the thermometer as



before, and the only difference is that the information from I is fed back to C not directly, but via the housewife H. The thermostat was invented when someone realized that in this function the housewife could quite well be replaced by a connecting rod !

If instead of an oven we now think of a house with central heating, our picture of the situation becomes further simplified, for the housewife now

can become her own temperature-indicator, and the functions of I and H are combined (Fig. 3).



We have reached an example in which one of the units of this basic flow-map is a human being. It is not difficult to think of examples where the other unit is also human. The relation of a rowing eight to their coxswain, for instance, can be depicted by the same basic diagram where the team combine the functions of S and C, and the coxswain acts as the indicator I. Again in a factory, C could represent a production team and I their manager. Examples are manifold; what we have been drawing is in fact the basic skeleton information map for goal-directed activity of any kind, whether human or mechanical.

The difference between human and mechanical situations—and it is a major one—lies not in the validity of these flow-maps, but in the complexity of the information-channels they must represent. The richness and variety of interconnexions between human beings makes most realistic flow-maps of social situations enormously more complicated than anything we have discussed. But when all this has been said by way of warning, it is still possible, for many purposes, to simplify the maps of human situations to manageable proportions and apply general principles with profit. This is particularly true of those situations in which questions of stability arise. Indeed it is the qualitative maxims of information system theory, rather than the quantitative calculations, which have the greater relevance to human affairs.

STABILITY

Let us then turn to the central question of the theory of information systems. Under what conditions is an active system stable? We have seen that instability arises when information is fed back in such a way as to reinforce the changes giving rise to it, instead of damping them down. Unfortunately it does not follow that an unstable system can always be made stable merely by reversing the direction of the feedback—even assuming we have the

power to do so. The problem is complicated by questions of the time taken for information to flow around the closed path of our map.

Suppose, for example, that we take a simple speed-regulator of the sort we have discussed, and introduce delay in the connexion between the indicator and the control, so that when the speed falls below standard it can go on dropping for some time before the trend is corrected, then go on rising above the standard for some time before it is brought back again, and so on. There is obviously a risk of this process building up into a continual succession of wild swings of speed, first in one direction and then in the other—a process known in the jargon as 'hunting'. It is in fact a common disease of self-regulating systems, and the diagnosis has by now been quite thoroughly worked out. Sluggishness in any part of a closed information-flow path is one of the chief causes of instability of this sort. In other words, if a system is disproportionately insensitive to rates of change of output, it is more liable to instability.

Oddly enough, the opposite fault can also lead to the same sort of behaviour, though this is not quite so easy to show in non-mathematical terms. Either too little or too much sensitivity to the rate of change of output—to the trend of activity—is a menace to the stability of any information system. The details of the theory show that a single unit with 'intertia' can often be tolerated without disastrous results, but that three or more such units in a closed information-path will always set up an unstable oscillation unless the sensitivity of the indicator is reduced below a certain figure.

REMEDIES FOR INSTABILITY

Now the upshot of all this in practical terms is seen when we ask how such instability may be remedied. Broadly, there are three prescriptions:

1. If instability is from the first cause, reduce delays and increase sensitivity to rates of change; i.e., make feedback 'anticipatory'.
2. If the second cause is operative, reduce sensitivity to rates of change and increase sensitivity to average levels.
3. If all else fails, reduce overall sensitivity.

A common example of the last remedy is the replacement of a hard washer in a ball-cock by a softer one to stop 'hammering'. The softer washer makes the cock less sensitive. Examples of the first two remedies are numerous in the design of automatic control systems, but may be less familiar. The question for us is whether any human information systems show similar phenomena, and if so, what form the analogous remedies might take. It may be emphasized again that this is not a question of applying the same mathematical methods of analysis, but only a matter of interpreting the same qualitative principles in the human context.

THE STABILITY OF SOCIAL INFORMATION SYSTEMS

Perhaps the example that comes first to mind is the economic system, with its notorious trade cycles of boom and slump. A considerable amount of work has been done to elucidate the details of this particular flow-map, and it now seems clear that the fluctuations are of the type we have been considering, being caused by certain defects of the complex feedback system through which most societies regulate their production and consumption. The difficulty is that this system comprises not just one closed information path, but many; and it is not always obvious at what points adjustments in sensitivity would help. Electronic analogue computers have recently been pressed into service to simulate such a system and enable experiments on this point to be carried out, and it may be hoped that practical suggestions may soon emerge.[1]

But perhaps of equal value is the converse possibility, that long-canvassed economic remedies for instability (e.g., fiscal policies and the like) can now be recognized in terms of information-system theory, and their significance appreciated in a new light. Some of Keynes' proposals, for example, are closely related to our remedy of 'anticipatory feedback' (1). On the other hand the remedy for creeping inflation must obviously be of type 2, and it is interesting to evaluate suggestions for dealing with it in these terms.

Only a brief indication can be given of other fields open to similar investigation. Systems of popular representation offer another obvious example, in which a comparison of the stability of different national systems is full of suggestive material for the information-system theorist. The implications of principles 1, 2 and 3 are more obvious in this field—the role of the press in providing anticipatory feedback and enhancing overall sensitivity is particularly clear and significant—but (for good or ill) their simplest practical expression would not always be compatible with democratic ideas of freedom of speech!

Other obvious examples are offered by the activities of trades unions, by the phenomena of advertising, and by competitive business practice. Here the allied subject of game theory has its contribution to make;[2] but to discuss it would take us too far. Enough has now been said to indicate the possible impact of these new disciplines on the theory of group behaviour.

1. In this context see A. Tustin, 'Economic Regulation through Control-System Engineering', *Impact*, Vol. IV, No. 2, Summer 1953.
2. In this connexion, see: M. Verhulst, 'Mathematics for Managers', *Impact*, Vol. VIII, No. 1, March 1957.

THE PREDICTABILITY OF INFORMATION SYSTEMS

One theoretical topic remains to be raised before we discuss the human organism itself as our final example. This is the question of the extent to which the activity of an information system can be predicted by someone who is a member of it. What light does the theory throw, for example, on the use of public opinion polls?

There are two kinds of fundamental limitation on prediction in these circumstances. The first arises even when the predictor is content just to keep his prediction to himself. It is simply the familiar fact that in order to collect enough data for a detailed prediction, one must disturb the system one is studying. Unreflecting people who have been quizzed for a poll, for example, are no longer typical, for they have been forced to reflect. Thus, although this need not invalidate one's calculations, it does mean that the answer is coloured in part by one's own action in sampling. The more closely one probes an information system, the more significantly one's action shares in determining rather than merely predicting it.

The second limitation may be less familiar but it is still more fundamental. It arises when the predictor wishes to *act* upon the basis of his prediction: when he plays an active part in the situation he wants to predict. In this case the information flow-map develops a kind of vicious circle. The prediction affects the action, which affects the basis of the prediction, which affects the action, and so on indefinitely. This again is true whether the predictors are mechanical or human. It is a property of any information system, that a complete prediction of it cannot be validly represented by an active part of the same system.

Consider for example the dilemma of Mrs. Brown, whose husband habitually asks for prunes when he sees her cooking porridge, and porridge when he sees her cooking prunes. Given sufficient psychological and other data, she might conceivably be able to predict perfectly accurately what his genuine preference will be tomorrow morning, as long as she keeps her prediction to herself and does not do any cooking. What is more, she knows precisely (we may assume) the laws according to which her husband's preference will be determined, if she does some cooking. And yet, no matter how long or how carefully she calculates, she is forever precluded from forestalling her husband's demand, for she herself is irreducibly part of the system which she wishes to predict.

This may seem a rather artificial example, but it is closely parallel to the dilemma of the large-scale speculator on the Stock Exchange, and indeed of any administrator who has to make a decision which will affect *conflicting* interests. No scientific discoveries in social psychology or anything else can be expected to remedy this fundamental unpredictability of an information system to a sufficiently participant observer.

MAN AS AN INFORMATION SYSTEM

This leads to our final question. To what extent is it possible to analyse and understand the human organism itself as an information system? Be it said at once that our knowledge of the details of the human nervous system is far too slender to allow the kind of direct map-making which we have so far considered. With something like 10,000 million nerve cells, the human information-system is unlikely ever to be analysed in this way. Our approach must be indirect, by way of hypothesis and test; and at best we may hope to arrive at only a kind of 'main trunk-route map' of the system.

This hypothetical 'model-making' is as yet in its infancy. It already however promises to serve a useful function as a kind of working link between the concepts of psychology on the one hand, and physiology on the other, especially in the understanding of mental disorder. The language of information theory has a foot, as it were, in both camps, so that evidence expressed in psychological terms can be interpreted in terms of information-flow so as to suggest a correlate in physiological terms, and vice versa. At the same time the information-flow model can itself be tested and refined and redefined as a result of clues gleaned from both fields.

It will be realized that this is quite a different matter from drawing analogies between brains and digital computing machines, which are in fact deliberately designed not to show most of the characteristics typical of a human being. It is not even a matter of building machines to imitate human behaviour, for imitations can be produced in many ways which would be quite unrealistic as models of brain processes. It is really the development of a new theoretical tool of research, intended only to grow and develop on paper so as to approximate progressively to the informational 'blueprint' of the brain.

FREEDOM AND RESPONSIBILITY

Needless to say, conclusions in this field are at best tentative. The most one can say as yet is that the barrier to our understanding of the brain is not any impossibility of reproducing human behaviour in a suitable information system. The difficulty is rather to decide which, if any, of a number of eligible candidates is the right model.

What then, one might ask, would become of human freedom if information theory *were* able to demonstrate eventually that all human behaviour could be accounted for in physical terms? It is often assumed that this would prove freedom to be illusory; but I believe this conclusion itself to be fallacious. It is reasonable that if I were about to make a choice, and if you could tell me with certainty what my choice would be before I made it, I

should excuse myself from responsibility for that choice (suspecting perhaps that I have been hypnotized). If, on the other hand, I can defy anyone to tell me with certainty the choice I am about to make, then I cannot escape responsibility, and I may claim to have chosen freely.

Now the fallacy mentioned lies in supposing that a complete knowledge of the physical basis of behaviour *could* enable anyone to give me an irrefutable advance prediction of a normal choice of mine. It is equivalent in fact to supposing that an information system could contain detailed information about its own future state. This, as we saw earlier, is irreducibly impossible—not on physical but on logical grounds. To be a man is to have an information system of this peculiar kind, which without defying any physical laws enables me to defy anyone to tell me with certainty my decisions in advance. Mr. Brown's freedom to upset Mrs. Brown's calculations arises not because his brain is physically 'queer', but because it is an information system with a particular logical structure, characteristic of the normal human organism.

Clearly this leaves open the possibility that someone who keeps quiet about it might successfully predict my decision in advance. There would seem to be serious practical barriers to such predictions, but there need be no objection to them from an ethical standpoint. The bulk of our normal choices are predictable, in this sense, to anyone who knows us well, without his even having to look inside our heads. But the question of responsibility turns on whether I have the *power* to falsify a prediction. A predictor who conceals his prediction is not demonstrating that I lack the power; he is only denying me the opportunity to show that I have it.

It is important to realize that this criterion of responsibility is not in principle a behavioural but a structural one. It is not a matter of offering a prediction and then watching to see whether the man falsifies it. He may prefer not to—if for example he is hungry and we predict to him that he will eat. The question is basically whether his information system is so organized that our intended description of its future state would be self-nullifying (as a description) if offered to him, because it would be self-referring.

The criterion thus reduces in essence to a question of the unity or wholeness of the man's information-flow system. If the controlling centres are so interdependent that the system functions as a single whole, his responsibility for his actions is assured by the foregoing criterion. If, however—as may well be the case in some mental disorders—the flow-system is broken up into relatively independent sections, it is entirely possible that the subject could be given advance descriptions of some of his actions, for which he could not then be held responsible.

THE IRRELEVANCE OF PHYSICAL INDETERMINACY

It will be realized that the criterion just suggested would apply equally well whether the brain were a physically determinate system or not. It thus cuts across the view that would make moral responsibility depend on theories that the brain is physically indeterminate. It may be suggested in fact that such a view of responsibility as conditional on physical indeterminacy is both misguided and immoral; misguided, because my responsibility is adequately nailed to my door if my choice is *logically* indeterminate until I make it—which we have seen to be true irrespective of the degree of physical indeterminacy in my brain; immoral, because a reliance on physical indeterminacy would deny my responsibility for any choices which did not entail any break in the chain of cause and effect in my brain, even though I made them deliberately, and could defy anyone to describe them to me with certainty beforehand.

Views of this kind are often put forward in order to make room for the 'action' of the mind on the brain. There is no wish to 'debunk' the mind—on the contrary, I believe most seriously in the spiritual as well as the physical aspect of human nature. But mental activity and brain activity are not necessarily to be pictured as *two* activities in quasi-physical interaction; they are two complementary aspects of one and the same activity, which in its full nature is richer—has more significance—than can be expressed in either mental or physical language alone.

It is not suggested that mental activity is 'nothing but' an aspect of brain activity: one might equally fallaciously maintain the converse. The idea is rather that each is a descriptive projection, so to say, from different logical standpoints, of a single complex unity which we can call simply human activity.

It would follow from this view that there is no need—indeed it would be fallacious—to look for a causal mechanism by which mind and brain could act on one another. Their unity is already a closer (and a more mysterious) one than if they were pictured as separate activities, one visible and the other invisible. Yet this is a unity which safeguards rather than threatens human responsibility, for it makes nonsense of any suggestion that my body, rather than I myself, could be held responsible for my choices. This would be simply to muddle up two languages in a meaningless statement—rather like asserting that when a man feels in love, his brain-cells do or do not feel in love.

IMPLICATIONS FOR PENAL THEORY

The discovery of an informational criterion which distinguishes responsible choices from other actions, irrespective of the degree of physical determinacy involved, seems to call for some rethinking of popular ideas with regard to the penal code. It is too often presupposed that an action is *either* free *or* the result of physical causes. If a physical cause could be found, it is taken as axiomatic that the man could not then be held responsible. It would seem to be strongly arguable that this view, despite its humane intentions, is a menace to human dignity; for if pressed to its logical conclusion, it would deny responsibility for choices (whether good or bad) for which it has been argued that a man has a *right* to claim responsibility.

The informational criterion on the other hand provides all the safeguards required to excuse those whose information systems are sufficiently disorganized, while rescuing the responsibility of a normal human being from any dependence on our ignorance of physiology or psychology. It would excuse the schizophrenic or the hypnotized subject, not on any grounds of physical causation, but on the ground (and to the extent) that an advance description of his action would not be logically indeterminate for him.

It would hold a normal subject responsible, not because of any absence of physical causation, but on the ground (and to the extent) that an advance description of his action would be logically indeterminate (because self-referring) for him.

In each case the criterion would be in principle a structural one, concerned with the organization of the subject's information system. This might have to be inferred from past observations of behaviour; but the criterion avoids the difficulty of some purely behavioural tests, which could be applied only by disturbing the subject in the act of choosing.

CONCLUSION

This survey has ranged rather widely and somewhat cursorily over the ramifications of information theory, and it may be well to draw some threads together in conclusion.

Before the advent of information theory, the notion of physical explanation had been restricted almost entirely to the reduction of phenomena in terms of energy-flow. Remarkably fruitful in the inanimate sphere, this approach has proved disappointingly sterile in the analysis of biological systems, and most of all in the study of man himself.

The emergence of 'information' as a basic scientific concept has provided a new tool with a function complementary to that of classical energetics. Though still in its infancy, the science of information-flow systems may well

revolutionize the study of living organisms and particularly the science of man.

The detailed working out of this new approach still lies in the future; the purpose of this article has been to extract some principles, new and powerful, whose application is wide and general and independent of the particularities of human nature which remain to be discovered.

Some of these principles relate to the problems of communication: the problem of the distortion, destruction and misapprehension of information, and the significance of 'redundancy' in enabling this to be overcome; the problem of information retrieval and the design of efficient filing systems.

Others are concerned with the behaviour of systems (any systems) organized by the flow and exchange of information, whether these be mechanical control systems, or human networks of social, economic or political relationships. Perhaps the central principles here are those relating to the stability of such systems. We have seen that this depends on the number, the sluggishness, and the sensitivity of the stages around which information circulates. Wherever closed paths for information exist, there is need to examine the possibility of instability. If instability arises owing to sluggishness, it may be remedied by artificially enhancing sensitivity to rates of change. But it can happen that too great a sensitivity to rates of change may also promote unstable oscillations; in that case an artificial enhancement of sensitivity to average level is required. At the worst, an overall reduction in sensitivity may succeed in restoring stability. The problem of devising economic or political means of making such adjustments in a free society may of course prove less tractable than that of specifying them; but these principles will have served their purpose if they enable efforts to be concentrated in profitable directions.

Finally, we have considered some fundamental limitations on the predictability of all such systems. We have seen in particular that no active member of an information system (e.g., no administrator) can make, or even accept as certain, a prediction on which he wishes to base a decision to change the system, if there is any conflict of interests involved. This is true irrespective of the degree of physical causality in the system.

Turning to man himself as an information system, we saw that the same principle offered a fundamental distinction between actions for which responsibility might be attributed, and those which might be excused—again on grounds independent of theories of physical causality in the brain. The implications for penal theory require more detailed discussion than could be given here; but the impropriety of treating physical causality as an excuse from responsibility seems clear.

Man is, indeed, a mystery; but we shall serve no purpose, moral or spiritual, by confounding this mystery with the purely scientific puzzles presented by the human information system.

BOOKS AND PUBLICATIONS

A Civilization in Fragments ?

Georges Friedmann, *Le travail en miettes,* Paris, Gallimard, 1956, 39 + 308 pp., price 850 francs.

The author of these lines remembers how much trouble he had, in 1949, finding books on the sociology of work which he could recommend to Italian students. For language reasons, all the English texts had to be excluded. Mr. Friedmann's recent books, one of which had been translated into Italian, came to his rescue and enabled him to initiate a small group of young people into the mysteries of a subject which undoubtedly will play an important role in the years to come.

In continental Europe, and especially in the Latin countries, Georges Friedmann will always be regarded as a pioneer. He has already found continuators beginning with his pupils; and he has, of course, his severe critics. It is, in any case, easy to criticize his works superficially. They are ardent excursions through a human material which has been given direct and minute study by their author. The way in which they are presented reflects the orderly, and sometimes the disorderly, way in which he has lived through and analysed certain experiences, not merely in libraries or laboratories, but in factories, workshops and offices, where most men spend the greater part of their active life, earning their daily bread and finding—or failing to find—much of their *raison d'être.*

Compared to its predecessors, *Le travail en miettes* is a fairly compact book. It is a monograph, a pamphlet, and a profession of faith which is all the more touching because it is less representative of the tendencies and preoccupations of those to whom these remarks are specifically addressed. One may well ask whether resistance to change—which is sometimes a necessary mental defence mechanism—does not, under the cover of all sorts of technical or logical arguments, often conceal moral hesitations. Accordingly, in the reviewer's opinion, the results of any scientific analysis of such burning questions should be stated without any subjective considerations, even though there is constant temptation to do so. Since the sub-division of tasks and its resulting disadvantages occur in a technical-economic framework which is common to all or almost all modern industry, both under capitalism and communism (and this seems to emerge clearly from several passages of the book), the introduction, even occasionally, of the political factor into the discussion can only add to the hesitations of fair-minded readers.

Here are two passages which are particularly illustrative of the author's personal opinion about a form of workers' education which might partially offset the havoc wreaked by the fragmentation of work among the working population :

> State socialism, whatever its benefits for the individual in the shape of educational facilities and chances of promotion, does not seem to satisfy his complex desire for 'participation'. This desire on his part is discouraged by over-centralization, hypertrophic bureaucracy, an upper crust of managers imbued with technocratic ideas, and the multitude of boards and committees whose decisions are in fact imposed upon him. Enterprises and administrations consist of large units which unduly restrict the margin of freedom wherewith the individual can express himself and make himself heard. . . . Community socialism, based on flexible, decentralized institutions, seems better adapted to the individual's psychological needs which, under it, can be harmonized with the use, by small teams, of modern techniques of organization and production. (pp. 260-1.)

And the second passage:

> In this ideal state . . . decentralization would not prevent the leaders from exercising a provisional, limited kind of enlightened despotism, for the purpose of guiding and supervising present and future mass media. We do not overlook the fact that human leisure is essentially compounded of choice and freedom; that it corresponds to individual inclinations, to tastes, in fact to a whole complex of tendencies, lodged in the very heart of the personality, which society must, so far as it can, respect. . . . If one looks at the way in which many men and women nowadays often employ their 'free time', . . . one is led to think that collective action is indispensable, at least in the present framework of society; such action alone can prevent man, after he has finished toiling for his bread (often, as we have seen, in a morally sterile if not positively harmful way), from being degraded rather than enriched by his leisure hours; such action alone can invest that leisure with the greatest possible cultural value and effectiveness. Given the corrosive anarchy which is all too frequently the rule today, an area of intervention and organization, centralized at State level (but naturally free of any totalitarian complexion) seems henceforth essential. (pp. 262-3.)

It would be difficult not to share most of the generous feelings reflected in these lines and in the rest of the book. Yet there is no gainsaying that this series of confessions and hopes raises or revives in the reader's mind many more problems—and graver problems at that—than the one in whose context they are set before us. Every sentence quoted above could give rise to long and complicated discussions. The ideology of a multiple, multivalent social system, in which almost every historic form of economic initiative and practice might be integrated and have a chance of survival in a state of dynamic and fertile instability, is not, after all, a Utopia. It is not so very far from the reality in which we live, and that is perhaps its weakness! Still, let us concentrate on the constructive elements in this book, if only by way of comments which will be mostly digressions directly inspired by the author's remarks. Before embarking upon this exercise, we might quote the following statement, which undoubtedly merits unreserved approval:

> Technical progress will yield good fruit only if it is accompanied by progress in the social sciences and by the judicious application of those sciences to the problems of the individual and the community. (p. 264.)

Mr. Roger Caillois' amusing remarks[1] about Freudian psycho-analysis and its adepts could be applied, with the same flavour of paradox and the same dash of malice, to the economists, and even more to that alliance between economics and technology which has produced, among other astonishing things, the most widespread, the most tenacious and often the most elusive forms of contemporary slavery.

Mr. Caillois speaks of the umbrella forgotten in some person's house. According to psycho-analytic interpretation, we, in our subconscious, passionately love that person; if it turns out that we don't love him, we needs must hate him; or else he is so completely indifferent to us that our subconscious suffers from hidden remorse, etc. 'A tous les coups l'on gagne.' It might be maintained that the 'laws' of economics follow the same process: their conclusions make explicit what was implicit in the original hypothesis. Gresham's Law, for example, teaches us that 'bad money drives out good'. But what is good and what is bad money? Is there an infallible sign which identifies their nature? Among the Dankali tribes, up to the beginning of the twentieth century, 'good' money consisted of bricks of salt with which they could buy all the merchandise for sale in the desert market; when they could exchange Maria Theresa dollars for bricks of salt, they were happy to do so. These coins, for them, were 'bad' money. But when they began to trade beyond the confines of their desert, they gradually discovered that merchants from the outside accepted the Maria Theresa dollars and refused the salt; they thereupon began to part with their salt more willingly and hoard coins instead. To 'keep' or 'hoard' something, instead of getting rid of it by exchange at the first opportunity—that is what makes any particular type of money 'good'. This amounts to saying that money is 'good', by definition, when people are unwilling to part with it if they can put a symbol of 'lesser' value into circulation in its place.

It must not be concluded that Sir Philip Gresham's advice to Elizabeth I was not judicious and even valuable advice; economists' opinions are generally worth something. However, it was tautological. Without referring to his theory, Sir Philip knew what kinds of money the Englishmen of his time did not like to part with; and he quite correctly told the Queen that if she allowed coins of less repute to circulate at the same time, they would soon be the only medium of exchange employed on the market.

Shaw's character who 'didn't like beets' could have no noticeable influence on the national and world beet markets; economists, producers and tradesmen could ignore him. But when such an attitude becomes general, it is a more serious matter, and not for 'economic' reasons. More than a century was required for Europeans to convince themselves that potatoes were not poisonous; still more time went by before they were enlightened, converted, moved

1. 'A tous les coups l'on gagne' (You can't lose), *Le Figaro Littéraire*, 6 April 1957.

—let the reader pick his own word—by the revelation that potatoes were really 'good' food. By what necessity in human nature *must* beets and potatoes be good? (And strictly speaking, is there such a thing as human 'nature'?)

There is a minimum level of existence—and it is hard to define—below which life generally becomes impossible, yet below which an almost infinite variety of goods and resources prevents us from sinking. Over and beyond it, it is man who chooses; he chooses between wheat and rice, between pork and lamb; he can even prefer want, if he is like the eccentric whose privations enabled him to save money wherewith to buy nails which were said to have come from Napoleon's boots. The preferences, selections and orders are those of man. When scores or millions of people make the same choice, we have a 'market', and the knowledge of economists, financiers and others becomes necessary to us. But the economic approach will never reveal how, when or why these choices are made, modified and abandoned by individuals, groups and peoples. Is it 'stereotypes of value' that determine the choice, or vice versa? And what are these stereotypes? How are they communicated from one mind to another? All these questions (and there are many more) lie beyond the economist's competence. When one or a hundred million people make a choice, the operations and the advice of economics become valid, *provided* that these same choices continue to be made by the same people and at the same rhythm, without entering into combinations with other, unforeseen choices or aversions.

Our civilization suffers from the inversion of the natural order of sequence of the two concepts of value and economics. We have come to assume that something must have value because it is 'economic', whereas in fact nothing is 'economic' unless it has a value, a *specific* value, for someone. A similar stereotyped assumption is the common idea that a proposition must be 'true' because it is 'scientific', whereas it ought to be 'scientific' only in so far as it is 'true'.

Woe betide us if ever the economists and scientists, with surreptitious but ineluctable help from the technicians, do the deciding about our needs and choices, and about the most economic and technically advanced methods of producing and distributing the things or services selected. As in the case of the forgotten umbrella, we shall always be in the wrong if we find that these techniques turn our work into slow torture, reducing us to a sub-human state; that we could be quite happy without buying most of these gadgets on the market; that the human ant-hills of the great industrial centres are places of horror, etc. The process is, as Mr. Friedmann justly remarks in his book, irreversible. Dominant stereotypes die or are outworn, but the road is one on which we are not allowed to turn back. There is not even a policeman on duty; the thing simply 'isn't done'.

In any case, the sciences of human behaviour are not required to lead us

back to places where we have already been; such places exist only in our memory, and the 'eternal return' is merely a theme for literature. These sciences ought rather to precede our car advancing laboriously on this boggy one-way road, and give us in time notice of the choices open to us and of the routes to be avoided. In addition, they ought systematically to analyse and explain man's real feelings and needs; this task, no doubt, is now their heaviest and most dangerous responsibility. All people concerned with education in the broad sense, with policy and administration, all those who combine a certain authority with a reasonable dose of intelligence and good faith, should encourage this research, if only by enlightened, positive criticism of its methods and results.

The fragmentation of tasks is not only a problem for the isolated individual confronted with the machine. For a long time now, a certain percentage of factory workers (especially, it would seem, women workers) have preferred repetitious, automatic work which requires no thought and little attention, and which they would not willingly exchange for a more 'individualistic' occupation. Mr. Friedmann appears inclined to underrate this aspect of the problem; he seems to think that, in as far as these attitudes exist, they must be deemed 'an evil', and an effort should be made to give these 'dejected' workers higher aspirations.

But the scientist, as such, is not called upon to judge the intrinsic value of existing attitudes; he merely notes and analyses them. Moreover, his analysis will be a better one if it is historical; by retracing the case-histories of 'dejected' workers, he can verify to what extent their personalities have been conditioned by the social and industrial environment, by life in general and by experience within the factory itself. He would then be surprised to observe the same 'indifference to incompletion', which apparently characterizes 'dejected' workers, among women—especially young women—in regard to their fiancés, families and homes! Yet in certain environments where the tradition of female employment in the factory is older and better-established, the women are not, as a rule, less concerned with their homes than are women elsewhere. The cause-and-effect relationship between employment and indifference to the household is less clear than one would have expected; the compulsory halt in home activities during working hours may well accentuate, rather than diminish, interest in family life.

The lack of sufficiently broad, thorough studies on this specific problem prevents us from evaluating the global impact of industrial life, in and around the factory, on personality-development, especially where a preference for repetitious work and a more or less complete lack of interest in one's own work are concerned. This reviewer has had some experience with peasants living near Carrara in Italy. Those who fairly regularly did an arduous day's work in the marble quarries, where they earned more than they would have

done as agricultural workers, seemed always to have 'less personality' than the peasants who remained faithful to their fields (except in certain cases where the choice of work had been imposed by critical financial circumstances). On the other hand, qualified miners doing no less heavy and often rather dangerous work in the quarries—work, however, which involved a certain degree of specialization and responsibility—gave the impression of having 'more personality' than the average peasant.

These are mere impressions. Particularly in recently industrialized countries, where industrial enterprises are in daily contact with an active agriculture, thorough and extensive research might lead to more valid generalizations on the effect which the general industrial 'climate' and the various industrial tasks have upon the personality, its ability to integrate and engage itself, its *Anschauung,* the level of intelligence, etc. Industrial sociology has of course been engaged upon such studies since its inception, with the classic work of Le Play. But our methodological requirements have increased since then; more specific conclusions and recommendations are expected from industrial sociologists. In the present state of our knowledge, it cannot fairly be denied *a priori* that piecemeal, quasi-automatic work is sometimes the livelihood of people who do not wish, or are unable, to do any better; when we have conceded that this reality weighs as heavily on our social conscience as on that of Mr. Friedmann, we must admit the fact itself. And once again, the first practical conclusion to be drawn is that the applied human sciences require to be developed certainly no less urgently than any other discipline. If indeed, as Alain (quoted by Mr. Friedmann) used to repeat, 'We have more power than knowledge,' it is because we have concentrated most of our scientific effort on the means of power, and have remained at a pre-Copernican stage with regard to our knowledge of man. We have given this 'unknown man' means and possibilities of action that strongly condition him, yet we are still unable to judge in what way they do so and with what results. This power, furthermore, throws man into situations and adventures for which we are not at all sure he is prepared; and we are not even able to say how and by what means he ought to be prepared for them.

Remedies of considerable practical value do exist. Many progressive industries show 'spontaneous' trends towards integrating divided-up work into a whole, towards broadening the scope of different jobs, towards shifting individuals and groups from one job to another in the same assembly-line or in the same factory, towards explaining the enterprise's general problems to its labour force, towards improving communications and generally fostering initiatives and techniques which come under the heading of 'human relations'. Such therapy is essentially symptomatic. The disease has so conditioned us that it becomes more and more difficult to distinguish good from evil. Sometimes a specialist in the applied human sciences is asked to analyse a specific industrial situation described as 'bad'. The question comes up at

once: 'Why bad? Bad for whom?' Obviously, bad for whoever is paying the specialist. Whereupon the value judgement—excluded by the 'pure' scientist on methodological grounds—sneaks in by the undefended back door of application and practical recommendations, because of the way the problem is set. Is there a problem if no one is aware of it? And if there are clear contrasts between the conceptions of the problem held by different people, what will the 'problem' be for the scientist?

This subject cannot be taken up here. An attempt to give at least an 'operational' reply to the question has been made by this reviewer in a short essay.[1] A more specific point is this: Has not the industrial civilization of our time developed, in all of us, a certain state of mind which tends to 'reduce to fragments' the fundamental values of the human personality? Every technique, every economic operation, tries to isolate particular problems, so that we may avoid dispersing our efforts and, at the same time, achieve the greatest possible number of favourable results. The scientific organization of work and the logic of Taylorism are only applications of the same principle to industry. In this sense, work in fragments is a success, and it only remains to face more critical individual cases in which such methods of work have had 'clinical' consequences. Otherwise, one may condemn the piecemeal labour system only if one is prepared to pronounce the same judgement upon an entire cultural structure (i.e., our own). Yet this structure has brilliantly solved a great many specific problems, at the cost of an almost total 'parcelling' of our concept of living.

> The author has learned from his observations . . . that when certain technicians spontaneously react against the traditional organization of labour, their initiatives (amounting to heresies) usually aim at restoring a certain margin of freedom to the team of workers. Because the number of small teams has greatly increased, it has become possible quietly to introduce these new methods into the rigid system laid down by the planning boards. It is as if modern industry were discovering (or rediscovering, in the wake of Aristotle and a few others) that man is an animal naturally designed for living and acting in society. His capacities and output are at their best when he works in a group. (pp. 63-4.)

This trend may today be observed at several levels, even in tertiary activities, in remote, 'higher' jobs where individual, strongly 'personalized' work has long been the rule. One can speak of the fragmentation of scientific work, which has become steadily more specialized and requires ever closer co-ordination between an increasing number of research workers, each of whom is concentrating on a steadily smaller field. In the applied sectors, too, an increasingly flexible and more complex team is required to cope with ever more delicate problems. The need for collaboration among different disciplines is realized more deeply every day.

1. C. Pellizzi, 'The Deontology of the Sociological Profession', *Transactions of the Second World Congress of Sociology*, I, pp. 164-70, 1953.

Concurrently, the operation of industrial enterprises of every kind calls for a greater proportion of persons whose jobs are planning and management, and the need for closer team-work within the administrative staff increases to the same degree. At either end of the hierarchical ladder, the same kind of spontaneous trend seems to be leading towards team action and stronger integration within the teams. Labour psychologists and sociologists have been studying these phenomena for a number of years, with increasing interest. It is as if our culture, after reducing human life and its concept of values to fragments, after reducing people to 'atoms' in a sufficiently well-fed but almost indiscriminate mob, were now trying to reconstitute, from the outside, multiple functional units, within which man would recover both his sense of the meaning of his work and his awareness of his own personality (and that almost means recovering his personality itself). Many sociologists have surrendered the more general problems of social life to the philosophers of history and to other specialists whom they regard with much distruct, and have given themselves over primarily to micro-sociology.

> The 'speciality of generalities' demanded by Auguste Comte is still justifiable today for the general comprehension and co-ordination of natural science problems. But it is certainly no longer possible in the human sciences. Nor can it be used to promote or apply political, economic, industrial or administrative techniques. Multivalent activity seems, today, to find itself in a dilemma slowly matured by the progress of mechanization. (p. 207.)

We can all agree about the present troubles of multivalent activity. But this reviewer notes a tendency to confuse two or three quite different things. The need for a 'speciality of generalities' is even more strongly, more painfully felt in the human sciences than in the natural sciences, and few of us have the courage to face that fact. The specialization of applied techniques is in any case inevitable. The need of which we are all intensely aware today, but which for the moment involves us in ever greater and more alarming difficulties, is for a macro-sociology or systematic study of the general problems of sociology—something akin, *mutatis mutandis,* to what general biology is in relation to the separate biological sciences.

How can we evaluate all the points we have been considering? How can we bring them into a general framework including, not only theoretical concepts, but also observations 'in the field' and even, if possible, experiments? For the subject, as we have seen, covers a great deal of ground: on the one hand, the fragmentation of tasks, the relatively reduced importance of all multivalent activity, the disintegration and near 'automatization' of the cultural interests of the masses, the atomization of the individual personality within the mob; and, on the other hand, these integrating tendencies which manifest themselves in small groups (as it may be observed in factories, in sports activities or in management), this mysterious synthesis along the peri-

phery which seems destined to create new networks of social relationships—a hitherto unknown structure, whose problems will confront us before we have fully grasped their basic elements.

Like most of the sciences, sociology began its history with a 'mythical' period characterized by broad intuition and exercises in generalization. Afterwards, it entered upon the 'heroic' phase of hard, discouraging struggle with elementary realities—field work, the fragmentation of problems, and attempts (very modest ones, where made by true scientists) to apply conclusions to concrete cases. And now, in a considerable part of the civilized world, people have already taken the habit of asking sociologists practical questions; they are disappointed when the answers are not so precise, so clear and so useful as those sometimes given by much older disciplines. Supposing we had asked an eighteenth-century hygienist to describe to us the aetiology and effective treatment of malaria, he would not have been able to tell us much; at the most he could have recommended the essence from a certain bark, quinine, because travellers have discovered that various American peoples had obtained good results with it. And sociological knowledge has not reached even that stage!

We venture to recommend that a beginning be made by 're-humanizing' sociology, for the reason that this discipline is at present greatly in need of general methodology and epistemology. It must frankly attack broad problems, revise its global concepts and perhaps, even, change its name. For when we say *socio-logy,* we seem to take it for granted that there is a generally accepted meaning of the word 'society'; yet the word can be applied to a variety of different things. The sociologist is obliged to base his work on this concept of the 'plurality of subjects', and one never knows whether the concept must be designated *a priori* (which would be methodological blasphemy) or whether it should indicate a frequent phenomenon relating to *certain* structures of behaviour. In the latter event, it is the structures of behaviour which ought to provide the initial basis for our discipline, and even its appropriate designation. This reviewer personally believes that there ought to be a discipline—quite distinct from psychological problematics—devoted to individual behaviour at the level of certain structures, just as there is the science of the behaviour of social groups, *at the same structural level.*

Present day technique obviously creates problems which were unknown at the beginning of the century. Political and cultural events are admittedly partly responsible for this; in any case, techniques are not natural phenomena, but arise from certain structures of behaviour. The new 'micro-societies' do not exist as 'facts' which may be studied, understood and classified without reference to the conscious, communicable behaviour patterns to which they owe their origin, their substance and their very existence. Let us repeat that the fundamental aspects of these behaviour patterns do not directly concern the psychologist, although we constantly have to enlist his

help in order to be sure that we have taken into account all the regular mechanism of behaviour which is his essential field of study.

A bath of general theory, without interruption in or detachment from direct field research (i.e., so to speak 'clinical work'), could help to bring sociology to maturity; in Vico's terms, sociology, after passing through its mythical and heroic phases, would reach its ultimate 'human' stage. The least enlightened mind can see that such development is an urgent matter. Elton Mayo called the industrial society of our time an adaptive society, in which stability was increasingly becoming the exception rather than the rule—a society in which adaptation, therefore, necessarily became the daily problem of man and his institutions. Mr. Friedmann throws light on a broad zone of adaptations which are both necessary and urgent. The reviewer agrees with him that these can no longer be restricted to matters of detail, however numerous and beneficial the adjustments may be; the earth could open up under our feet while we were engaged in stopping a quantity of small holes. The age of nuclear energy, automation and vast integrated international structures demands more courageous, more radical social science and social thought. The old saying that one must not be afraid of having courage was never truer than it is today. The ideologies which are evoked with a certain nostalgia in this book can no longer satisfy even the leaders of the countries whose régimes have been built on them. We see ever more clearly that the basic problems are, or tend to be, the same for both sides of the world, and that neither side is possessed of an intellectual and scientific equipment adequate to solve these problems.

Let us simply deal with three of the many problems raised by Mr. Friedmann: man's 'depersonalization' in work, and his new integration into small groups; the effects of 'incompletion'; and leisure. And let us, at the risk of digressing, try to assess the gravity and scope of these problems.

The close interdependence between personality and sociality appears to be an accepted fact. We know that the sociality of the old, relatively stable cultures 'broke up' under the action of industrial development; we note all the phenomena of the 'solitary mob' of our time; and we know that the active principle which underlay what might be called our techno-economy, far from having lost its momentum, is still operating at a dangerously accelerated pace. Adaptation techniques are being spoken of. The question then is: adaptation of what, to what?

First point: adaptation of the personality? But where is it henceforward to be sought? We know that all or almost all the conditions in which it is formed and its sociality produced can be, and often are, upset by some extremely powerful force arising out of the discoveries of the natural sciences and having its 'laws' in our techno-economy. Shall we not finally be divested of the residue of that incorporeal substance, the erstwhile 'individual

personality'? The whole world cries out: 'Save the personality!' That, up to now, was the war-cry of industrial sociology. But even the small, relatively well-jointed working groups in which the man-society relationship now seems to have recovered some of its importance are constantly threatened with abolition or radical transformation by some decision emanating from a scientific laboratory or resulting from some techno-economic calculation. We who cultivate the human sciences and are concerned with 'personality hygiene' have come to seem like that Queen of France who is said to have recommended cake to the people clamouring for bread. The substance of the personality concept should be discussed, at an early stage, with the theologians; not only are they still, despite everything, more powerful than we, but they have recorded an infinite number of variations in this concept throughout the long history of their discipline, and they could supply us with valuable information.

Second point: adaptation of the personality to what? An adaptation is a kind of compromise between two constants. Supposing we have found an adaptive constant on the side of the 'personality', to what other constant will it correspond on the other side? The logical profile of our techno-economy is sufficiently clear-cut. Yet it would be impossible to say as much for the results produced by scientific laboratories; and even the time-lag between the moment of discovery and that of application, which has hitherto been one of the safety-valves of social development, may be almost eliminated by technology, especially where strong political pressure is at work. In the reviewer's opinion, this problem in itself ought to become the nucleus for a relatively new and fairly complex discipline.

> The general phenomenon regularly observed among factory workers and described as 'boredom' or 'dissatisfaction' has a complex causal background. . . . Research by experimental psychology into the incompletion of tasks does not give a full explanation . . . yet appears to shed light on some of the problem's principal aspects, in the industrial environment. . . . When a job has been done, it is easy to forget it. Unfinished, however, it is a weight on the memory and can even prey on the mind. . . . It seems . . . that when, as the saying goes, we 'buckle down' to a job, we mobilize a quantity of emotional energy which then insists on being employed. Our whole personality finds itself in a state requiring the completion of the assignment. . . . Jobs with definite contours, whose completion is easy to define, are those which least endure interruption. . . . Persons who are incapable of grasping the internal structure of a task and the way in which its parts are related to the whole are relatively insensitive to the effects of incompletion. Thus, workers engaged on fragmentary tasks devoid, for them, of meaning have much less impulse to finish what they are doing, and consequently are much less subject to frustration, boredom or dissatisfaction with incompletion, than others. This, by the way, may be one of the circumstances explaining the fact . . . that women in many cases accept work in 'broken parts' more willingly than men. (pp. 111-13.)

The reviewer admits he does not understand the last two remarks in this passage. As we already noted, and as fairly early research seems to have established, some workers (generally women) prefer repetitious, almost

automatic work. These people are 'relatively insensitive to the effects of incompletion', and it would therefore appear that they are 'less subject . . . than others' to frustration and dissatisfaction with incompletion. In other words: if one takes a certain objective degree of incompletion of the assignment as a constant, the degree of frustration will depend upon the subject's attitude of mind, upon his more or less intense desire to grasp the internal structure of the job he is doing and to complete it. Moreover, if the subject's attitude is adopted as a constant, the variable 'monotony and incompletion of the task' will not only cause boredom; it will probably have its effects upon the total orientation and structure of the worker's personality, his use of leisure-time, etc. As for the attitude of women, it is hard to see how the difference between women's and men's attitudes is explained by what is stated in this passage.

But the first part of the quotation is much more important for us. The eminent psychologists whose experiments are related here (we have not quoted this part of the passage) seem to have suffered from that same 'parcelling-up' spirit which has been deplored in this review; and Mr. Friedmann, in accepting one of their interpretations uncritically, has been manoeuvred into making an involuntary concession to the demons of our time.

What appears to characterize the problem is the general relationship, manifested by behaviour (in the broadest sense), between the subject and his assignment. It must be imagined that all the 'dimensions' and complications of the subject's personality *can* come into play, where the task (completed or not) is concerned. The explanation constituted by the 'quantity of emotional energy' which is enlisted when the work is undertaken and which 'insists on being employed', like the alarm in an alarm clock, leaves us most unsatisfied. Even the English expression quoted in this regard, 'conative perseveration', seems devoid, if not of all import, at least of any explanatory value. The problem arises here to a great extent in terms of the *Gestalt* theory, which has done much to call attention to the essential link in this chain—namely, significant behaviour, at which point all the disciplines dealing with behaviour meet. Frustration due to unfinished work, and boredom from automatic, repetitious work, seem closely associated with the human capacity to form concepts and with the suffering caused when this faculty is systematically repressed in work. The mechanical metaphor of the word 'release' is approximately correct if a single aspect of the phenomenon is considered, and not the way in which it is differentiated from other forms of behaviour. The behaviour structure in regard to a task is a conscious ritual which one must, and likes to, obey; it is a pattern capable of being transmitted and not only shared with other people, but retained throughout the life of the subject himself, as part of the possible content of the conscious memory. The remembrance of the unfinished task will recur more frequently, because the shock of forced incompletion has given it more substance; but there would

have been no shock if the task as a whole had not been clearly present in the mind when the work began, or at least when it had to be interrupted.[1]

At this point in observable reality, the historical factor repeatedly impinges upon the regular motions of physiology and psychology and conditions them, while continuing to be conditioned by them. And the idea of the historical factor at once reminds us of the specific preoccupations of the discipline generally known as 'sociology'. If Mach could say that 'nature only happens once', there is all the more reason for saying so of the conscious and semi-conscious actions of man. However, at this level, as at all observable levels, it is possible to collect equivalent data, establish correlations, attempt extrapolations or, in short, found another science parallel and complementary to the historian's work, which is mainly centred upon understanding the original character of specific facts and their sequence in time. The sociologist's task will be a systematic study of the regularities in the structures of conscious behaviour, carried out in close collaboration with the psychologist (who studies regular behaviour without reference to the 'incursions of history') and the ethnologist or cultural anthropologist (who traces the history of these same structures and makes broader comparisons possible). It is quite obvious that these three disciplines (together with history, which appears at every juncture like a stern guide) must work in common whenever a 'synchronized' analysis of a complex human event has to be made.

What is directly involved in all that has been summarized here is the personality. It is not the duty of the human sciences to 'save' the personality, or anything else. But they must systematically analyse, not only the observable realities which go to make up the so-called 'personality', but its correlations with all other natural and cultural factors, its dynamics in this complex interplay of forces. Those sciences must therefore, after taking all imaginable precautions and making all possible reservations, venture, if need be, upon extrapolations from the known to the unknown, from the past and present to the future. It will be for the men and women, mighty and humble, of this world to decide what they wish to do and what they wish to 'save'.

These fairly wide digressions in regard to Mr. Friedmann's fine book should not be brought to an end without a few words on the problem of leisure. It seems to afford our author some relief from the righteous wrath inspired in him by the causes and consequences of 'piecemeal' labour.

> There are various degrees of compulsion in every kind of work, and some psychologists . . . have even made the presence of this element the principal basis for determining whether a given human activity must or must not be called 'work'. (p. 126)
>
> It may be noted, in passing, that a need has grown up, in all the principal languages for an expression equivalent to 'killing time. . . .'. The spiritually 'alienated' creature

1. On this fundamental point, and on other rather closely related points, the reviewer can refer to his own article 'La struttura elementare del comportamento consapevole' (The elementary structure of conscious behaviour), in *Scritti di Sociol. e Polit. in onore di L. Sturzo*, III, Rome, 1953.

of capitalism's technical civilization is unhappy: 'In consuming amusement, he seeks to repress his awareness of his own misfortune. He strives to gain time and then worries about killing the time he has gained' (Erich Fromm). Dissatisfaction with work in fragments is, in the author's opinion, one of the main aspects of this 'alienation'. (p. 196.)

Modern personnel services, Douglas McGregor notes, practically consider work as a kind of punishment which people must undergo in order to find their satisfaction elsewhere. (p. 239.)

Work, . . . when it has a certain wealth of content and engages some of the worker's personality, plays a fundamental part in his general equilibrium, his adaptation to his social environment, and his physical and mental health. It has had this role throughout history, in every variety of social and cultural setting. . . . Viewed from this angle, will not the weakening of the part work plays in human life, the gradual replacement of human tasks by automatic processes, have very harmful effects? . . . Do those leisure-time occupations to which the centre of personal activity and accomplishment is transferred provide the same advantages and the same psychological *virtues* as professional work? (pp. 256-7.)

Since it is said that a good review ought to be a kind of anthology, we have here chosen four passages which our author apparently uses as 'reference positions' for the leisure problem. This reviewer would venture even further than the author in certain conclusions, but one of those quoted above gives rise to considerable hesitation.

'To kill time' is a venerable expression, used in all the languages known to us. It would be unfair to make modern industrialism responsible for the formula, and especially for the thing itself. The story goes that an old gentleman used to sit before his empty cup of coffee in a café on the Piazza San Marco in Venice until well into the night; he was alone and obviously doing nothing. Whenever a passing friend asked him 'What are you doing, Cavaliere?' he invariably replied, 'I am waiting for it to be late.' This anecdote must be at least a hundred and fifty years old!

'Time-killing' behaviour may be observed among the rich, in towns or in country seats, or among peasants in remote hamlets. It is an attitude found in all periods and places and seems to reflect a feeling of monotony, a lack of novelty or variety in the life one leads; it has an obviously pathological character. Its influence is undoubtedly important, though hard to evaluate, in the tendency which has always impelled people to move to the great cities. It is vaguely imagined that 'something always turns up' in cities; if, in order to go there from the country, one must accept work in industry, one does so. Not that one has any special liking for such work, but it seems a harmless condition for enjoying city life—going to the cinema in the evening, knowing a lot of different things and people. There is also the vaguer thought that one can 'make one's fortune'. But as a rule the city worker soon starts to 'kill time', just as he did on the farm.

It might be assumed, as a working hypothesis, that leisure, the use of free time, is a fundamental problem affecting all aspects of our life, and that it should be given concentrated attention by the disciplines concerned with the fate of human beings. On closer inspection, it is seen to be the problem

of whether man does, or does not, 'suffice unto himself spiritually'. Industrialism, urbanism and work in fragments show us this problem in a new setting, where it sometimes appears more acute, more alarming for the future; but to concentrate on existing situations, however widespread, without having an outline of a general theory on the theme 'work and leisure', may not be a good method.

Since the now remote days when the reviewer used to read Huizinga's classic little book, he has always thought that there must be a very close correlation between the following two concepts: the game which amuses is a game which absorbs, and satisfying work is work in which the worker is interested (and not merely for economic reasons). No antagonism need exist between these two concepts; potentially, they converge. The *ideal* of play and the *ideal* of work are identical. When we discuss the interest-value of different activities, it matters little whether the name given to them is 'work' or 'hobby'. Their differing degrees of 'sociality' can also be argued about; it may be advocated that one's play should have a more social character when one's work is solitary, and vice versa; some occupations involve physical fatigue, others mental fatigue, etc.

In all this, the problem of compulsion, which Mr. Friedmann rightly emphasizes, must not be ignored. Yet it should not be forgotten, either, that compulsion is a regular and probably essential part of the dynamics of the personality. It is found in religious rites (probably the most striking and basic elementary structure in human behaviour). This 'necessary option', in which Maurice Blondel saw the highest form of religious conviction, manifests itself in work—and in play, if it is satisfying to man—in roughly the same way. The game becomes insipid (a conditioned, sub-human, morbid ritualism) without a coercive factor, without the *a priori* acceptance of an inviolable rule regarding the difficulties and obstacles met with. The Maoris in New Zealand, for whom war had become the best of 'ritual games', offered some of their ammunition to the British troops invading their country when those troops ran out of their own, because otherwise all the fun of the battle would have been spoiled.

From primitive ritual distractions to the most refined modern pastimes, 'education in play' is always to be found, even in the most poorly organized societies. The dear old lady who 'cheats' at solitaire should remain the eternal symbol of one of the most vicious tendencies of the human personality! In all integrated societies, 'education in play' forms part of the training of all young people and becomes more rigorous in the upper classes. The feudal knight and the English gentleman, to take only two examples, were those who *played the game*—in war, at tournaments, in hunting and shooting, in business, love and sport. 'A la table et au tablier, on connaît le chevalier' remains a highly significant old proverb.

This leads us to the subtleties of etiquette, which still has essential

importance in all forms of cultural life, including work and play. Its rigid and often contradictory rules can be easily ridiculed; still, two centuries have not yet gone by since a young man with red heels on his shoes could, in the very heart of our civilization, get himself bravely killed at dawn over some delicate matter of deportment. Etiquette is stationed along the road leading from elementary ritual (conscious and communicable) to the higher forms of taste and creative talent.

In conclusion, to come back to our immediate topic, we may well ask whether our industrial or techno-economic culture has not done more than reduce to fragments a whole sector of labour activity. It may have had the same effect on certain fundamental structures and conditions of our existence —those which (without provoking a revival of the rituals, games, tastes, etiquette and higher mental activities of past civilizations) might still make it possible to establish conscious rituals, forms of play involving the whole personality, tastes which were not mere bad habits, etc. These things give individuals and societies the opportunity to fulfil themselves and find a 'meaning' in life.

CAMILLO PELLIZZI

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